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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XB435]

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Construction of the South Fork Offshore Wind Project

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; issuance of an incidental harassment authorization.

SUMMARY: In accordance with the regulations implementing the Marine Mammal Protection Act (MMPA) as amended, notification is hereby given that NMFS has issued an incidental harassment authorization (IHA) to South Fork Wind, LLC (South Fork Wind) to take, by Level A harassment and Level B harassment, marine mammals during construction of a commercial wind energy project offshore New York, Rhode Island, and Massachusetts.

DATES: This IHA is valid from November 15, 2022 through November 14, 2023.

FOR FURTHER INFORMATION CONTACT: Carter Esch, Office of Protected Resources, NMFS, (301) 427-8421. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act.* In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq*.) direct the Secretary

of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed incidental take authorization (ITA) may be provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in shorthand as "mitigation"); and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

The definitions of all applicable MMPA statutory terms cited above are included in the relevant sections below.

Summary of Request

On March 15, 2019, NMFS received a request from South Fork Wind for an IHA to take marine mammals incidental to construction of an wind energy project offshore of New York, Rhode Island, and Massachusetts. Following a delay of the project, South Fork Wind submitted an updated version of the application on June 3, 2020, and then a revised version September 14, 2020. The application was deemed adequate and complete on September 15, 2020. However, on December 15, 2020, South Fork Wind submitted a subsequent application due to changes to the project scope. NMFS deemed the

application adequate and complete on December 16, 2020. A notice of the proposed IHA was published in the **Federal Register** on February 5, 2021 (86 FR 8490). In response to South Fork Wind's request and in consideration of public comments, NMFS has authorized the taking of 15 species of marine mammals by harassment. Neither South Fork Wind nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

Description of Activity

South Fork Wind plans to construct a 90-180 megawatt (MW) commercial offshore wind energy project in the South Fork Wind Farm (SFWF) Lease Area OCS-A 0517 (SFWF; Figure 1 here, and see Figure 1 in the IHA application for more detail), southeast of Rhode Island within the Rhode Island-Massachusetts Wind Energy Area (RI/MA WEA), including an export cable corridor connecting the SFWF to one of two landing locations on Long Island, New York. The project would consist of the installation of up to 15 offshore wind turbine generators (WTGs) and one offshore substation (OSS), an onshore substation, offshore and onshore cabling, and onshore operations and maintenance facilities (Figure 1). Each WTG would interconnect with the OSS via an inter-array submarine cable system. The offshore export cable transmission system would connect the OSS to an existing mainland electric grid in East Hampton, New York. A temporary sheet pile cofferdam may be installed where the offshore export cable conduit exits from the seabed to contain drilling returns and prevent the excavated sediments from silting back into the Horizontal Directional Drill (HDD) exit pit. The final location of the cofferdam will be dependent upon the selected cable landing site. Alternatively, a temporary casing pipe may be used in place of the cofferdam at the same location.

Take of marine mammals may occur incidental to the construction of the project due to in-water noise exposure resulting from 1) impact pile-driving activities associated with installation of WTG and OSS foundations, 2) vibratory pile driving associated with

the installation and removal of a temporary cofferdam nearshore, or impact hammering and vibratory pile driving associated with installation of a casing pipe, and 3) surveys, using high-resolution geophysical (HRG) equipment, of the inter-array cable and export cable construction area (construction surveys).

South Fork Wind plans to install the WTGs and OSS in the 55.4 square kilometer (km^2) (13,700 acre) Lease Area (Figure 1). At its nearest point, the SFWF would be approximately 30 kilometers (km) (19 miles (mi)) southeast of Block Island, Rhode Island, and 56 km (35 mi) east of Montauk Point, New York. The South Fork Wind export cable routes (SFEC) would connect SFWF to one of two landing locations on Long Island, New York, where a temporary cofferdam or casing pipe may be installed where the SFEC exits the seabed. Water depths in the SFWF and SFEC range from approximately 33-90 meters (m) (108-295 feet (ft)).

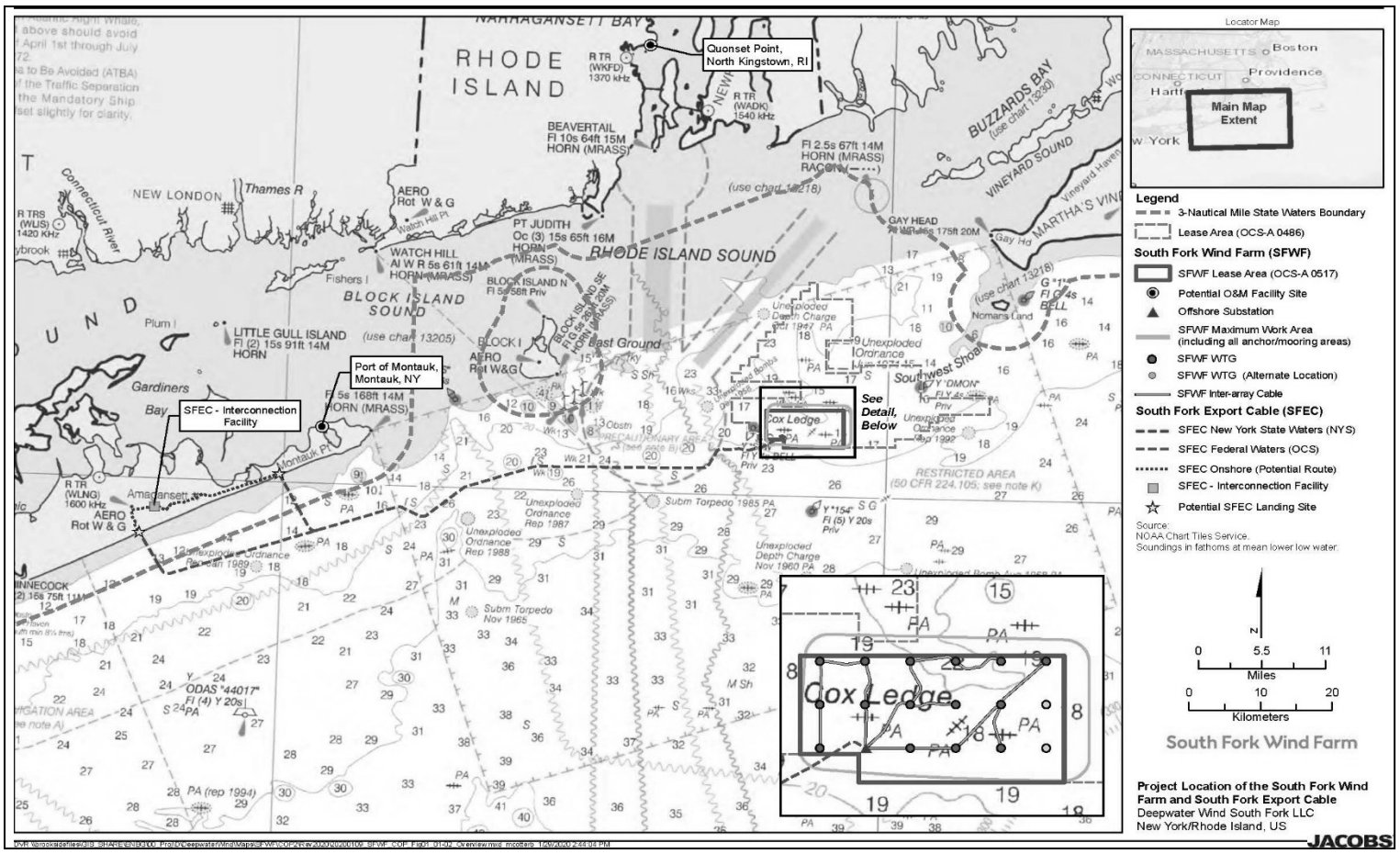

Figure 1. Location of Lease Area OSC-A 0517, South Fork Wind Farm (SFWF), and Potential Export Cable Routes (SFEC)

Since publication of the proposed IHA, South Fork Wind communicated to NMFS that construction of the project, beginning with the nearshore cofferdam or casing pipe, is now planned to commence in November 2022, rather than between April and May 2022 (as indicated in the proposed IHA). Either the temporary cofferdam or casing pile and support piles may be installed for the sea-to-shore cable connection and, if required, would likely be installed between November 2022 and May 2023 (removal could occur anytime through the expiration of the IHA). If used, installation and removal of the cofferdam are each expected to take 18 hours of vibratory pile driving. Alternatively, installation and removal of the casing pipe and support piles are each expected to take approximately four hours.

Up to 16 days of impact pile driving to install the WTGs and OSS may occur on any day between May 1, 2023 and November 14, 2023. The monopiles supporting the WTGs and OSS (the maximum number would be 16 to correspond to 1 OSS and the maximum of 15 WTGs) will be installed between May 1, 2023, and November 14, 2023. For monopile installation, a typical pile-driving operation is expected to take approximately 2-4 hours to achieve the target penetration depth. No more than one monopile could potentially be driven into the seabed per day. Accordingly, concurrent driving (*i.e.,* the driving of more than one pile at the same time) would not occur. Up to 60 days of construction surveys may be conducted throughout the 12-month period of effectiveness of the IHA.

Cable Laying

Cable burial operations will occur both in the SFWF for the inter-array cables connecting the WTGs to the OSS and in the SFEC for the cables carrying power from the OSS to land. Inter-array cables will connect the 15 WTGs to the OSS. A single offshore export cable will connect the OSS to the shore. The offshore export and inter-array cables will be buried in the seabed at a target depth of up to 1.2-2.8 m (4-6 ft). Installation of the

offshore export cable is anticipated to take approximately 2 months. The estimated installation time for the inter-array cables is approximately 4 months. All cable burial operations will follow installation of the monopile foundations, as the foundations must be in place to provide connection points for the export cable and inter-array cables. Installation days are not continuous and do not include equipment preparation or downtime that may result from weather or maintenance. Equipment preparation is not considered a source of marine mammal disturbance or harassment.

Some dredging may be required prior to cable laying due to the presence of sand waves. The upper portions of sand waves may be removed via mechanical or hydraulic means in order to achieve the proper burial depth below the stable sea bottom. The majority of the export and inter-array cable is expected to be installed using simultaneous lay and bury via jet plowing. Jet plowing entails the use of an adjustable blade, or plow, which rests on the seafloor and is towed by a surface vessel. The plow creates a narrow trench at the desired depth, while water jets fluidize the sediment within the trench. The cable is then fed through the plow and is laid into the trench as it moves forward. The fluidized sediments then settle back down into the trench and bury the cable. The majority of the inter-array cable is also expected to be installed via jet plowing. Other methods, such as mechanical plowing or trenching, may be needed in areas of coarser or more consolidated sediment, rocky bottom, or other difficult conditions in order to ensure a proper burial depth. The jet plowing tool may be based from a seafloor tractor or a sled deployed from a vessel. A mechanical plow may also deployed from a vessel. More information on cable laying associated with the project is provided in South Fork Wind's Construction and Operations Plan (SFWF COP; South Fork Wind, 2020). As the only potential impacts from these activities are sediment suspension and very low noise emissions, the potential for take of marine mammals to result from these activities is so low as to be discountable and South Fork Wind did not request, and NMFS does not

authorize, any take associated with cable laying. Therefore, cable laying activities are not discussed further in this document.

Construction-Related Vessel Activity

During construction of the project, South Fork Wind anticipates that an average of approximately 5-10 vessels will operate during a typical work day in the SFWF and along the SFEC. Many of these vessels will remain in the SFWF or SFEC for days or weeks at a time, potentially making only infrequent trips to port for bunkering and provisioning, as needed. Although South Fork Wind estimates that 20 one-way transits between the SFWF and port(s) will be required per month, the actual number of vessels involved in the project at one time will be highly dependent on the project's final schedule, the final design of the project's components, and the logistics needed to ensure compliance with the Jones Act, a Federal law that regulates maritime commerce in the United States.

Existing vessel traffic in the vicinity of the project area southeast of Rhode Island is relatively high and marine mammals in the area are expected to be somewhat habituated to vessel noise. In addition, construction vessels would be stationary on site for significant periods and the large vessels would travel to and from the site at relatively low speeds. Project-related vessels would be required to adhere to several mitigation measures designed to reduce the potential for marine mammals to be struck by vessels associated with the project; these measures are described further below (see **Mitigation**). As part of various construction-related activities, including cable laying and construction material delivery, dynamic positioning thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of dynamic positioning thrusters is similar to that produced by transiting vessels, and dynamic positioning thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. Sound produced by dynamic positioning thrusters would be preceded by, and associated with, sound from ongoing vessel noise and would be similar

in nature; thus, any marine mammals in the vicinity of the activity would be aware of the vessel's presence, further reducing the potential for startle or flight responses on the part of marine mammals. Construction-related vessel activity, including the use of dynamic positioning thrusters, is not expected to result in take of marine mammals and South Fork Wind did not request, and NMFS does not authorize, any takes associated with construction-related vessel activity. Accordingly, these activities are not discussed further in this document.

Installation of WTGs and OSS

A monopile, the only type of foundation that will be installed, is a single, hollow cylinder fabricated from steel that is secured in the seabed. The monopiles installed would support up to 15 WTGs and single OSS, and would be 11 m (36 ft) in diameter, up to 95 m (312 ft) in length and driven to a maximum penetration depth of 50 m (164 ft). A schematic diagram showing potential heights and dimensions of the various components of a monopile foundation are shown in Figure 3.1-2 of the SFWF COP (South Fork Wind, 2020), available online at: *https://www.boem.gov/renewable-energy/state-activities/south-fork*.

All monopiles would be installed with a hydraulic impact hammer. Impact pile driving entails the use of a hammer that utilizes a rising and falling piston to repeatedly strike a pile and drive it into the ground. Using a crane, the installation vessel would upend the monopile, place it in the gripper frame, and then lower the monopile to the seafloor. The gripper frame would stabilize the monopile's vertical alignment before and during piling. Once the monopile is lowered to the seafloor, the crane hook would be released and the hydraulic hammer would be picked up and placed on top of the monopile. A temporary steel cap called a helmet would be placed on top of the pile to minimize damage to the head during impact driving. The largest hammer South Fork Wind expects to use for driving monopiles produces up to 4,000 kilojoules (kJ) of energy

(however, required energy may ultimately be far less than 4,000 kJ). As described in the **Mitigation** section below, South Fork Wind would utilize a single big bubble curtain (BBC) paired with an additional noise mitigation device, or a double big bubble curtain (dBBC) during all impact pile driving of monopiles.

The intensity (*i.e.*, hammer energy level) of impact pile driving of monopiles would be gradually increased based on the resistance from the sediments that is experienced. The strike rate for the monopile foundations is estimated to be 36 strikes per minute. Two impact pile-driving scenarios for monopile installation were considered for SFWF (Table 1). The standard impact pile-driving scenario would require an estimated 4,500 strikes for the pile to reach the target penetration depth, with an average installation time of 140 minutes for one pile. In the event that a pile location presents denser substrate conditions and requires more strikes to reach the target penetration depth, a difficult-to-drive pile scenario was considered, for which 8,000 strikes and approximately 250 minutes would be required to install one pile.

Installation and removal of temporary cofferdam

Before cable-laying HDD begins, a temporary cofferdam could be installed at the endpoint of the HDD starting point, where the SFEC conduit exits from the seabed. The cofferdam would be less than 600 m (1,969 ft) offshore from the mean high water line (MHWL), in 7.6 to 12.2 m (25 to 40 ft) water depth, depending on the final siting point. The cofferdam, up to 22.9 m (75 ft) by 7.7 m (25 ft), would serve as containment for the drilling returns during the HDD installation to keep the excavation free of debris and silt. The cofferdam may be installed as either a sheet pile structure driven into the seabed or a gravity cell structure placed on the seafloor using ballast weight. Installation of a gravity cell cofferdam would not result in incidental take of marine mammals and is not analyzed further in this document. Installation of the 19.5 m (64 ft) long, 0.95 centimeters (cm)

(0.375 inches (in)) thick Z-type sheet pile cofferdam, and drilling support, would be conducted from an offshore barge anchored near the cofferdam.

If the potential cofferdam is installed (using sheet piles), a vibratory hammer would be used to drive the sidewalls and endwalls into the seabed to a depth of approximately 1.8 m (6 ft); sections of the shoreside endwall would be driven to a depth of up to 9 m (30 ft) to facilitate the HDD entering underneath the endwall. Cofferdam removal would consist of pile removal using a vibratory hammer, after HDD operations are complete and the conduit is installed (see Table 1 for a summary of potential vibratory pile-driving activity).

Vibratory hammering is accomplished by rapidly alternating (~250 Hertz (Hz)) forces to the pile. A system of counter-rotating eccentric weights powered by hydraulic motors is designed such that horizontal vibrations cancel out, while vertical vibrations are transmitted into the pile. The vibrations produced cause liquefaction of the substrate surrounding the pile, enabling the pile to be driven into the ground using the weight of the pile plus the impact hammer. If the gravity cell installation technique is not practicable, South Fork Wind anticipates that any vibratory pile driving of sheet piles would occur for a total of 36 hours (18 hours for installation, 18 hours for removal).

The source levels and source characteristics associated with vibratory pile driving would generally be similar to those produced through other concurrent use of South Fork Wind's vessels and related construction equipment. Any elevated noise levels produced through vibratory pile driving are expected to be of relatively short duration, and with low source level values. However, it is possible that if marine mammals are exposed to sound from vibratory pile driving, they may alert to the sound and potentially exhibit a behavioral response that rises to the level of take.

Installation of casing pipe

The temporary casing pipe could be installed at the currently planned exit pit location. The casing pipe would be driven into the seabed at the approach angle of the HDD, and would extend from the seabed up through the water column to the sea surface where a work vessel would be able to access the open end of the pipe. The casing pipe may require that temporary support piles be installed to ensure pipe stability. Temporary support piles would consist of up to 8 steel sheet piles temporarily driven into the seabed using a vibratory pile driver. It is anticipated that the casing pipe would consist of a steel pipe pile, approximately 48- to 60-inch diameter and approximately 300 feet in length; installation would likely be accomplished using a small pneumatic impact hammer (*e.g.* Grundoram Taurus or similar), to drive the pipe in the seabed. It is estimated that the hammer operates at up to 18.6 kJ and that impact hammering of the casing pipe would take approximately two hours complete. Installation of the steel sheet support piles would take an additional two hours. Once the HDD operation has been completed, the casing pipe and support piles would be removed over a similar timeframe and using a similar methodology to that used for installation. As mentioned previously, acoustic impacts associated with installation of the casing pipe (and support piles, if needed) are expected to be less than or equal to, and over a much shorter duration than, impacts from installation of a cofferdam. South Fork Wind will determine whether a cofferdam or casing pipe will be installed, if required. However, installation of a cofferdam was carried forward in the analyses here, given the large size of the Level B harassment zone and the longer duration of the activity.

Table 1. Summary of Pile-driving Activities For SFWF and SFEC

Pile-driving method	Pile size	Number of piles	Strikes/pile	Duration/pile	Number of piling days
Impact	11 m monopile	16	Standard pile: 4,500	Standard pile: 140 minutes	Standard scenario:30
			Difficult pile: 8,000	Difficult pile: 250 minutes	Maximum scenario:20
	19.5 m long/			18 hours	Installation: 1-3

Vibratory[1]	0.95 cm thick sheet pile	80[2]		18 hours	Removal: 1-3

[1] South Fork Wind would install either the sheet pile cofferdam or casing pipe, not both. Because vibratory pile driving associated with cofferdam installation/removal results in the largest harassment zones and requires the most amount of time, this activity was carried forward in our analysis (see Estimated Take section).
[2] Approximation; the actual number will be based on final engineering design.

Construction Surveys

The construction surveys would be supported by up to four vessels working concurrently throughout the project area. Construction surveys would occur throughout the 12-month period of effectiveness for the IHA. HRG survey equipment would either be deployed from remotely operated vehicles (ROVs) or mounted to or towed behind the survey vessel at a typical survey speed of approximately 4.0 knots (kts) (7.4 km) per hour.

Table 2 identifies all the representative HRG survey equipment that operates below 180 kilohertz (kHz) (*i.e.*, at frequencies that are audible and have the potential to disturb marine mammals) that may be used in support of planned construction survey activities, and are likely to be detected by marine mammals given the source level, frequency, and beamwidth of the equipment. For discussion of acoustic terminology, please see the **Potential Effects of Specified Activities on Marine Mammals and their Habitat** and **Estimated Take** sections in the notice of the proposed IHA (86 FR 8490; February 5, 2021).

Table 2. Summary Of Representative HRG Survey Equipment

HRG Equipment Category	Specific HRG Equipment	Operating Frequency Range (kHz)	Source Level (dB rms)	Source Level (dB 0-peak)	Beamwidth (degrees)	Typical Pulse Duration (ms)	Pulse Repetition rate
Shallow Sub-bottom Profilers	ET 216 (2000DS or 3200 top unit)	2–16 2–8	195	-	24	20	6
	ET 424	4–24	176	-	71	3.4	2
	ET 512	0.7–12	179	-	80	9	8
	GeoPulse 5430A	2–17	196	-	55	50	10
	TB Chirp III - TTV 170	2–7	197	-	100	60	15
Medium Sub-	AA, Dura-spark UHD (400 tips, 500 J)[1]	0.3–1.2	203	211	Omni	1.1	4

bottom Profilers	AA, Dura-spark UHD (400+400)[1]	0.3–1.2	203	211	Omni	1.1	4
	GeoMarine, Geo-Source or similar dual 400 tip sparker (≤800 J)[1]	0.4–5	203	211	Omni	1.1	2
	GeoMarine Geo-Source 200 tip light weight sparker (400 J)[1]	0.3–1.2	203	211	Omni	1.1	4
	GeoMarine Geo-Source 200-400 tip freshwater sparker (400 J)[1]	0.3–1.2	203	211	Omni	1.1	4
	AA, triple plate S-Boom (700–1,000 J)[2]	0.1–5	205	211	80	0.6	4

- = not applicable; NR=not reported; AA=Applied Acoustics; dB=decibel; ET=EdgeTech; J=joule; Omni=omnidirectional source.

[1]The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the survey. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available.

[2]Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP-D700 and CSP-N). The CSP-D700 power source was used in the 700 J measurements but not in the 1,000 J measurements. The CSP-N source was measured for both 700 J and 1,000 J operations but resulted in a lower SL; therefore, the single maximum SL value was used for both operational levels of the S-Boom.

A detailed description of South Fork Wind's planned construction activities is provided in the notice of the proposed IHA (86 FR 8490; February 5, 2021). Since that time, South Fork Wind has not proposed any changes to its construction activities through the IHA process, other than the casing pipe alternative to installation of a temporary cofferdam at the exit pit location of the export cable (as described above and below). Therefore, a detailed description is not provided here. Please refer to that notice for the detailed description of the specified activity. Mitigation, monitoring, and reporting measures are described in detail later in this document (please see **Mitigation** and **Monitoring and Reporting** below). Modifications and additions to the mitigation and monitoring measures have occurred since the proposed IHA was published. All changes since the proposed IHA have been summarized in the **Changes from Proposed IHA to Final IHA** section and described in detail in their respective sections and/or the comment responses below.

Comments and Responses

Comment 1: The Marine Mammal Commission (Commission) claims that ranges to the Level B harassment isopleth for impact pile driving of 11-m monopiles are underestimated by JASCO (the source of the modeling used for NMFS' analysis) for the South Fork Wind project because, primarily, Lippert *et al.* (2016) indicated that JASCO's time-domain finite difference pile-driving source model (TDFD PDSM) predicted lower sound exposure levels (SELs) in the far-field region than various finite-element (FE) models. The Commission notes that while the exact source level difference between the TDFD PDSM and FE models was not reported, Lippert *et al.* (2016) indicated that the SELs predicted by JASCO's TDFD PDSM were approximately 2.5 dB lower than the SELs predicted by the FE models at 750-m distance from the source. To help resolve this issue, the Commission suggests that JASCO could add 3 dB to the SEL predictions from the TDFD PDSM to be consistent with differences identified in Lippert *et al.* (2016). In addition, the Commission suggests that NMFS could use the dampened cylindrical spreading model (DCSM; Lippert *et al.*, 2018) to substantiate the Level B harassment zones. Finally, the Commission seeks clarity regarding the models that JASCO used, and how JASCO's model(s) would compare to the model used for the COMPILE workshop benchmark case in Lippert *et al.* (2016).

Response: The Commission 1) recommends adding 3 dB based on the COMPILE workshop comparison (Lippert *et al.* 2016), 2) recommends that NMFS use the DCSM to substantiate Level B harassment zones, and 3) seeks an explanation of the models JASCO used and how JASCO's model(s) would compare to the model used in the COMPILE workshop benchmark case. Adding 3 dB (or 2.5 dB, the value from which the Commission apparently rounded up to 3 dB) to the JASCO SEL predictions at 750 m may bring JASCO's predictions using the TDFD PDSM into line with the FE predictions for the COMPILE scenario, but it is not clear that this would be more accurate. This approach assumes that the FE models are correct, but Lippert *et al.* (2016) also state "a

drawback of [the FE] approach is that it simulates the energy loss due to friction in an indirect and rather nonphysical way." Therefore, NMFS has concluded that adding 3 dB to the SEL predictions from JASCO's TDFD PDSM is not warranted.

NMFS agrees that there can generally be utility in comparing the results of analogous models, but the Commission's suggestion to use the DCSM (Lippert *et al.*, 2016) as a way to verify the range to the Level B harassment isopleth predictions estimated by JASCO is problematic. The DCSM is a modified geometric model of propagation that applies a general correction for the interaction of sound with the environmental parameters (*e.g.*, absorption, and the assumption of cylindrical spreading), whereas the full-wave parabolic-equation based propagation model (FWRAM (<2kHz)), and Gaussian beam ray-trace model (BELLHOP (>2kHz)) JASCO used take into account environmental interactions (*e.g.*, bathymetry, sound velocity profile, geoacoustic properties of the seabed) as the sound propagates. BELLHOP was inadvertently excluded from the acoustic modeling report (Denes *et al.*, 2020a), but is run along with FWRAM as part of the acoustic modeling. The DCSM assumes an apparent source level for different pile sizes and then uses a simple model of propagation. While NMFS agrees that DCSM is a valuable tool for some applications, JASCO's well-tested, range-dependent propagation models based on solutions to the wave equation represent the preferred alternative to the simpler DCSM.

The Commission seeks clarity regarding the models used by JASCO. The force at the top of each monopile, associated with the typical hammers, was computed using the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010), which produced forcing functions. The source signatures of each monopile were predicted using the TDFD PDSM to compute the monopile vibrations caused by hammer impact. To accurately calculate propagation metrics of an impulsive sound, a time-domain representation of the pressure wave in the water was used. To model the sound waves

associated with the monopile vibration in an acoustic propagation model, the monopiles are represented as vertical arrays of discrete point sources. The discrete sources are distributed throughout the length of the monopile below the sea surface and into the sediment with vertical separation of 3 m. The length of the acoustic source is adjusted for the site-specific water depth and penetration at each energy level, and the section length of the monopile within the sediment is based on the monopile hammering schedule (Table 6). Pressure signatures for the point sources are computed from the particle velocity at the monopile wall up to a maximum frequency of 2,048 Hz. This frequency range is suitable because most of the sound energy generated by impact hammering of the monopiles is below 1 kHz.

As mentioned above, to calculate predicted propagation of sounds produced during impact pile driving of monopiles below 2 kHz, JASCO used it's FWRAM, which is an acoustic model based on the wide-angle parabolic equation (PE) algorithm (Collins 1993). FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments. It takes environmental inputs (*e.g.*, bathymetry, sound velocity profile, and seabed geoacoustic profile) and computes pressure waveforms at grid points of range and depth. Because the monopile is represented as a linear array and FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012), using FWRAM ensures accurate characterization of vertical directivity effects in the near-field zone. JASCO used BELLHOP, a Gaussian beam ray-trace model that also incorporates environmental inputs, to model propagation of sound produced above 2 kHz during monopile installation. The beam-tracing model is basically described as an approximation of a given source by a fan of beams through the medium. Then, the quantities of interest (*e.g.*, acoustic pressure at different ranges) are computed at a specified location by summing the contribution of each of the individual beams.

The acoustic source signature of vibratory driving of sheet piles was modeled following the same steps used to model impact pile driving of monopiles. The forcing function was modeled for a single cycle of the vibrating hammer using the GRLWEAP 2010 wave equation model (Pile Dynamics 2010). The TDFD PDSM model was used to compute the resulting sheet pile vibrations from the stress wave that propagates down the sheet pile. The radiated sound waves were modeled as discrete point sources over the 18 m (60 ft) of the sheet pile in the water and sediment (9 m [30 ft] water depth, 9 m [30 ft] penetration) with a vertical separation of 10 cm. Sound propagation of the discrete point sources was predicted with JASCO's Marine Operations Noise Model (MONM). MONM computes received sound energy, the SEL, for directional sources. MONM uses a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM). Similar to FWRAM and BELLHOP, MONM incorporates site-specific environmental properties. MONM treats frequency dependence by computing acoustic transmission loss at the center frequencies of 1/3-octave-bands. At each center frequency, the transmission loss is modeled as a function of depth and range from the source. Composite broadband received SELs are then computed by summing the received 1/3-octave-band levels across the modeled frequency range.

The accuracy of JASCO's TDFD PDSM has been verified by comparing its output against benchmark scenarios (Lippert *et al.*, 2016). In addition, JASCO compared the TDFD PDSM predictions to an empirical model prediction in the Institute of Technology and Applied Physics (ITAP) report (Bellmann 2020). The empirical model is based on a large data set of pile-driving sounds, measured at 750 m from the source, collected during installation of various diameter piles (up to 8 m) during wind farm installation in the North Sea (ITAP, Bellmann 2020). As no noise monitoring results exist for 11-m monopiles (yet to be installed offshore), the ITAP prediction facilitates a way of

validating the source levels of the numerical FD model. The ITAP data are averaged across different scenarios – pile sizes, different hammers, water depths, depths of penetration, and environmental conditions – and the 95th percentile level is reported, whereas the aim of JASCO's modeling is to estimate the median value. While the ITAP forecast and the FD source predictions were comparable, there is variance in the underlying ITAP data and there are parametric choices for the FD model in the different environments, so an exact match is not expected. As part of the comparison, it was found that different (but reasonable) parametric input choices in the TDFD modeling can result in output differences on the order of the variance in the ITAP data, so it was concluded that the TDFD modeling approach performed as well as can be discernible given the available data.

Comment 2: The Commission claims that *in situ* measurements collected during the installation of Dominion's Coastal Virginia Offshore Wind (CVOW) project's 7.8-m monopiles suggest that the range to the Level B harassment isopleth for installation of 11-m monopiles presented here has been underestimated. Specifically, the Commission notes that JASCO estimated the Level B harassment zone for South Fork Wind's impact driving of 11-m piles to be 4,684 m, assuming a 10-dB sound attenuation, based on the use of a single BBC and up to 4,000 kJ of hammer energy (see Tables 12 and 13; Denes *et al.* 2020a), while *in situ* measurements made during the CVOW project for impact driving of a 7.8-m pile with a measured 9-12 dB sound attenuation during use of a dBBC for a hammer operating at a maximum of 550 kJ estimated the Level B harassment zone to be 3,891 m (WaterProof 2020).

The Commission suggests that South Fork Wind's use of an impact hammer with 7.3 times more energy intensity than the impact hammer used for CVOW (4,000 kJ versus 550 kJ) spread over a 1.4 times larger circumference than the pile size used in CVOW, would result in approximately five-fold (or 7 dB) higher sound energy level than

was determined for CVOW. Based on DCSM, a 7-dB difference in source levels, the measured Level B harassment zone of more than 3,800 m at Dominion, and environmental conditions for Dominion, the Commission claims that the measured Level B harassment zone would increase by 81 percent, resulting in a Level B harassment zone of approximately 6,890 m based on the increased hammer energies and pile size. Further, the Commission suggests using DCSM to relate this range to the Level B harassment isopleth to the acoustic propagation conditions in the South Fork Wind project area, which the Commission states would result in a Level B harassment zone of more than 9,600 m for the South Fork Wind project.

Response: Recent acoustic measurements associated with the installation of two 7.8-m-diameter piles, with the hammer operating at 550 kJ, driven as part of the CVOW project found the range to the Level B harassment isopleth (160 dB rms) to be 3,891 m, while JASCO's prediction for 11-m piles with hammer energy of 4000 kJ was 4,684 m. Both efforts employed comparable mitigation – JASCO assumed broadband attenuation of 10-dB for acoustic modeling, while 9-12 dB of attenuation was measured at CVOW using a dBBC situated around the pile to attenuate noise produced by impact hammering of the pile. The Commission reasons that because the hammer energy used in JASCO's acoustic propagation modeling is approximately 7.3 times the energy of the hammer employed for CVOW, JASCO's predicted range to the Level B harassment isopleth should be more than double that measured at CVOW instead of being approximately 20-percent larger. The 3,891-m range to the Level B harassment isopleth reported for CVOW was obtained by choosing the maximum measured SPL value produced during impact pile driving of the monopile. JASCO's predictive modeling produces median (expected or 50th percentile) SPL values. The 50th percentile SPL values in CVOW (Waterproof 2020; Table 4.1) are 5-6 dB lower than the maximum. Using the CVOW 50th percentile SPL values and the acoustic propagation equations in the CVOW report

results in a range to Level B harassment isopleth of approximately 2,000 m, which is less than half of the 4,684-m range predicted by JASCO for installation of monopiles by South Fork Wind. JASCO uses the sound fields predicted during acoustic modeling in subsequent animal movement modeling to estimate probabilities of exposure. In the exposure analysis, the median (equivalently, 50th percentile) sound level values are preferred so that the probabilities represent likely occurrence. Using maximum or 95th percentile sound field values would systematically bias the marine mammal exposure probabilities.

Regarding the Commission's estimates of zone sizes using the DCSM, these are approximations but, in general, NMFS agrees with the logic presented by the Commission, if one were to use that model. However, as described above, JASCO's predictions are for the expected (median) SPL, while the predictions for CVOW use the maximum measured SPL values. If a 7-dB difference in source level is expected with the larger hammer and larger pile (compared to CVOW) South Fork Wind plans to use, it should be noted that there is an approximately 5-dB difference between the measured maximum SPL and the 50th percentile SPL for the CVOW project, so JASCO's approximately 20-percent increase in the range to the Level B harassment isopleth (relative to the range measured for the CVOW project) seems reasonable for a source level difference of 2 dB. It should also be noted that there is greater than 5-dB difference in the levels measured at closest location to the pile reported for the CVOW projects, indicating that concepts like source level do not really apply to distributed sources and that propagation may not be captured well with simple models like DCSM.

Comment 3: The Commission seeks clarity regarding the type and configuration of the bubble curtain South Fork Wind will utilize during impact pile driving. In addition, the Commission references Bellmann *et al.* (2020), in which the authors report an average of 9-dB sound attenuation utilizing a BBC as a noise mitigation device for

installation of 8-m monopiles in 40 m of water. The authors indicated diminishing efficacy of the BBC with increasing water depth, suggesting that additional noise mitigation devices should be used for pile diameters greater than or equal to 6 m installed in water depths greater than 25 m.

Response: The Commission is correct that Bellmann (2020) reported an average of 9-dB (7 < 9 < 11dB) attenuation using a BBC for a water depth of 40 m, but this was for an air flow rate of $0.3m^3/(min*m)$. South Fork Wind will use an air flow rate of at least $0.5m^3/(min*m)$ for BBC deployments. As increased air flow results in a stronger BBC, this will effectively result in more attenuation than reported in Bellmann *et al.* (2020). Further, the final IHA requires that South Fork Wind not use a single BBC as the only means of noise mitigation, meaning they must pair a single BBC with an additional noise mitigation device; alternatively, they may use a dBBC. South Fork Wind is committed to reducing noise levels generated by pile driving to the lowest levels practicable such that they do not exceed a noise footprint modeled, assuming a 10-dB attenuation. South Fork Wind is required to prepare and submit a Pile Driving Plan to NMFS for review and approval 90 days before the start of pile driving. As part of this plan, South Fork Wind must include specifications of the bubble curtain(s) and additional noise mitigation device(s) that will be used during impact pile driving, as well details on how the bubble curtain(s) and additional noise mitigation device(s) will be deployed to reduce noise levels to the maximum extent practicable.

Comment 4: The Commission states that estimated ranges to the Level B harassment isopleth in JASCO's underwater acoustic modeling report (Denes *et al.* 2020a) are smaller than those used in its animal exposure modeling report (Denes *et al.*, 2020b), and indicated that it is not clear which zones are correct.

Response: The acoustic range estimates in the animal exposure modeling report (Denes *et al.*, 2020b; Tables 12 and 13) are approximately 100 m longer than those

shown in the acoustic modeling report (Denes *et al.*, 2020a; Tables E13 and E14). Tables 12 and 13 in the animal exposure report show the acoustic ranges to the Level B harassment isopleth for the most conservative case - the impact hammer with greater range and at the highest hammer energy level for summer and winter, respectively. Tables E-13 and E14 of the acoustic modeling report show the SPL ranges to various isopleths, assuming 10-dB attenuation, for the IHC S-4000 hammer and Menck 3500S hammer, respectively, at two modeling locations (P1 and P2). The Menck 3500S operating at 3500 kJ produced slightly longer ranges (Table 14) than the IHC S-4000 operating at 4000 kJ (Table 13). Using the Menck 3500S data (Table 14), the ranges to the Level B harassment isopleth in winter are 4,769 (P1) and 4,718 (P2), for an average of 4,744 m. Likewise, the ranges to the Level B harassment isopleth in summer are 4,443 (P1) and 4,403 (P2), for an average of 4,423 m. The corresponding ranges to the Level B harassment isopleth, assuming 10-dB attenuation, in the animal movement modeling report are: 4,535 m (summer; Table 12) and 4,832 m (winter; Table 13). There is an approximately 10-m difference when comparing the summer values (4,423 m vs 4,535 m) and winter values (4,744 m vs 4,832 m). Zones are not used in animal movement modeling (3D sound fields are) so animal exposure estimates are not affected by the apparent small difference of zone radius. Zones are shown in the animal exposure modeling for reference purposes only.

Comment 5: The Commission seeks clarity regarding 1) how sound field verification (SFV) will be conducted should lesser hammer energies be required for installation of the first monopile(s), which might not be representative of the required hammer energies and associated acoustic impacts for later piles, and 2) the required mitigation and monitoring should the measured range to the Level B harassment isopleth exceed the range produced by acoustic propagation modeling, assuming 10-dB attenuation (4,684 m).

Response: South Fork Wind will be required to conduct SFV on multiple piles to capture the spectrum of hammer energies required to install monopiles in varying substrates throughout the project area. Specifically, they will monitor the first 3 piles and, if a subsequent piling location is selected that was not represented by the previous locations (*i.e.*, substrate composition, water depth), additional SFV will be required. South Fork Wind has committed to mitigating noise produced by impact pile driving, such that the ranges to harassment isopleths align with those modeled, assuming 10-dB attenuation. If the ranges measured for the first pile are larger than those modeled, South Fork Wind will be required to make a series of adjustments to the sound attenuation measures, including (and in the following order): 1) a reduction in the hammer schedule (the number of strikes at a given energy level), 2) modifications to the bubble curtain(s), and 3) implementation of an additional noise mitigation device to further refine noise mitigation. In the interim between SFV of the first evaluated pile and the next, South Fork Wind must conduct both visual and acoustic monitoring of the zones associated with the measured ranges to the Level A harassment and Level B harassment isopleths for the first pile. Should additional SFV demonstrate that the ranges to the Level A harassment and Level B harassment isopleths are still greater than those modeled assuming 10-dB attenuation, the IHA (see condition 5(f)(iv)) states that NMFS may adjust the Level A harassment and Level B harassment zones, and the associated mitigation and monitoring zones accordingly, for the installation of the remaining monopiles. In this case, visual monitoring would be adjusted accordingly by shifting the location of the secondary PSO vessel to approximately half the measured range to the Level B harassment isopleth. Clearance and shutdown zones would be adjusted according to condition 5(f)(iv) of the final IHA. In all cases, passive acoustic monitoring (PAM) will supplement visual observations. South Fork Wind is required to establish a PAM system designed to facilitate localization of baleen whale calls within a 5-km radius of

the impact pile-driving vessel; however, the PAM system will likely have a detection range of 10 km or more, thus providing ample acoustic monitoring coverage should the Level B harassment zone be increased in size. Depending on the extent to which Level A harassment and Level B harassment zones are expanded, reinitiation of consultation under Section 7 of the ESA with NMFS GARFO may be required.

Comment 6: The Commission 1) claims that JASCO's assumptions used to seed its animat modeling were not appropriate, 2) questions whether the 7-day simulations used in JASCO's exposure modeling appropriately accounted for the 16 days of proposed pile driving, and 3) suggests that animal exposure modeling could have been accomplished using 100 Monte Carlo simulations for the 140 and 250 minutes of activities for installation of standard and difficult-to-drive piles, respectively, producing density scaled estimates for each activity that could then be multiplied by the number of days of activities.

Response: It is unclear what the Commission means when claiming that JASCO's seeding for animat modeling was not appropriate. However, the use of 7-day simulations can be addressed. Representative 7-day periods of project construction were simulated (*e.g.*, piling every day, or every other day). NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2018) recommends a 24-hour accumulation period, so 24-hour sliding windows (with 4-hour advancements) within the 7-day simulations were used to find the average exposure expected in a 24-hour period that includes pile driving. This provides a more robust probability calculation of 24-hour exposure estimates compared to a single-day simulation. The average 24-hour estimate is then scaled by the number of days of pile driving (*i.e.*, 15 days of standard pile installations plus 1 day of a difficult-to-drive pile installation). It is unclear why the Commission suggests conducting 100 Monte Carlo simulations (or to what that comment is referring); however, multiple simulations were run. For example, the piling-every-day

simulations consisted of approximately 140 minutes of pile driving in each day of the simulation. JASCO simulated tens of thousands of animats and determined the average exposure probability in a 24-hour period. That probability was then scaled using the real-world density of different species to estimate the number of individuals expected to exceed a threshold. Note, if the Commission's suggested use of 100 Monte Carlo simulations is referring to a Monte Carlo approach to sampling from the different predictions in a 24-hour period, this could be done but would arrive at the same mean estimate as scaling the averaged estimates by the number of pile-driving days, and thus NMFS determined the use of Monte Carlo simulations is not warranted.

Comment 7: The Commission notes that NMFS did not increase the proposed numbers of take resulting from impact pile driving to at least the average group size (based on DoN (2017)) for Level B harassment take of sperm whales, long-finned pilot whales, and Atlantic spotted dolphins, and Level A harassment take of blue whales. In addition, the Commission claims that NMFS did not propose to authorize an appropriate number of Level A harassment takes of fin whales, Level A harassment and Level B harassment takes of humpback whales, and Level B harassment takes for common dolphins and bottlenose dolphins during impact pile driving, given the frequency of occurrence and group sizes observed in the South Fork Wind project area during previous monitoring efforts (A.I.S., Inc. 2017, Smultea Sciences, 2020).

Response: Animal movement modeling that accounts for exposure within the sound field was used to estimate take. However, NMFS concurs that density models and animal movement models may not capture all site-specific conditions nor year-to-year fluctuations in animal distributions. Where modeled takes were zero, South Fork Wind requested Level B harassment take for the following species based on cited references rather than on DoN (2017): sperm whales (Barkaski and Kelly, 2018) and long finned pilot whales (Kenney and Vigness-Raposa, 2010).

Given that South Fork Wind already conservatively requested (and NMFS proposed to authorize) 3 Level B harassment takes of sperm whales (or one group size; Barkaski and Kelly, 2018) despite animal exposure modeling resulting in zero Level B harassment takes of sperm whales, NMFS determined that no further increases in authorized take are warranted.

Upon further review of scientific literature, NMFS updated the reference for average group size for long-finned pilot whales (n=20; CETAP 1982) and increased authorized take by Level B harassment from 12 to 20 (Table 18). Atlantic spotted dolphins were sighted on two occasions (approximately 20 individuals total; average group size of 10) during recent monitoring efforts near the South Fork Wind project area conducted over a 7-month period and covering over 11,000 km of survey trackline (Smultea Sciences, 2020). Similar monitoring efforts within the South Fork Wind project area covering 9,597 km from June through September 2020 detected zero Atlantic spotted dolphins (Gardline 2021). Barkaski and Kelly (2018) report an average group size of 13 for Atlantic spotted dolphins, which is similar to the average group size based on sighting data near the South Fork Wind project area (10; CSA 2021). To account for group size, NMFS has conservatively increased take, by Level B harassment, of Atlantic spotted dolphins from 2 to 13 (Table 18).

NMFS does not agree that take, by Level A harassment, of blue whales should be increased. Rather, upon further review, and based on the lack of blue whale sightings during previous monitoring efforts within and near the South Fork Wind project area (Smultea Sciences, 2020; Gardline 2021), NMFS has determined that any take, by Level A harassment or Level B harassment, of blue whales resulting from the project's construction activities is *de minimus* and, therefore, NMFS has not authorized take of blue whales by Level B harassment. Tables 18 and 23 have been revised to reflect this

change from the notice of the proposed IHA, which included the proposal of one take, by Level B harassment, of a blue whale.

South Fork Wind requested, and NMFS proposed to authorize, one take, by Level A harassment, and 6 takes, by Level B harassment, of fin whales incidental to impact pile driving. The Level A harassment zone, assuming 10-dB attenuation, is 1,769 m for fin whales. Given that the shutdown zone for fin whales (2,000 m) is larger than the Level A harassment zone (1,769 m), and the relatively small number of monopiles planned for installation, NMFS has determined that no increases in take, by Level A harassment or Level B harassment, of fin whales incidental monopile installation, are warranted.

Because the Level A harassment zone for humpback whales (3,642 m, assuming 10-dB attenuation) is larger than the 2,000-m shutdown zone, South Fork Wind requested and NMFS proposed to authorize, 4 takes, by Level A harassment, of humpback whales in addition to 8 takes, by Level B harassment. NMFS has determined that, due to the relatively small number of monopiles planned for installation, 4 takes by Level A harassment and 8 takes by Level B harassment are appropriate for authorization.
Upon further review of scientific literature (DoN 2017; Smultea Sciences, 2020; CSA 2921; AMAPPS 2021), NMFS has conservatively selected the largest group size reported among references for common (35; AMAPPS 2021) and bottlenose (21.6; AMAPPS 2021) dolphins to incorporate into increases of take, by Level B harassment, for each species. The group size for each species was multiplied by the number of days on which impact pile driving of monopiles may occur (16), resulting in 560 common dolphin and 346 bottlenose dolphin takes, by Level B harassment.

Comment 8: The Commission noted several perceived inconsistencies, errors, and omissions in the **Federal Register** Notice of the proposed IHA (86 FR 8490; February 5, 2021) and the proposed authorization, including:

1) Omission of shutdown, Level A harassment, and Level B harassment zones in Table 2 of the proposed IHA;

2) Lack of alignment of mitigation and monitoring measures between the **Federal Register** notice and the proposed IHA;

3) Need to clarify that the 5,000-m clearance and 2,000-m acoustic shutdown zones for North Atlantic right whales (NARWs) will minimize the potential for Level A harassment, but not necessarily Level B harassment (as stated in the notice of the proposed IHA).

Response: The harassment, clearance, and shutdown zone ranges (which were included in the notice of the proposed IHA but erroneously excluded from the draft IHA) are now included in the final IHA (Tables 2-6) and align with corresponding tables in this notice. All mitigation and monitoring measures now align between this notice and the final IHA. In the final IHA, NMFS is requiring that South Fork Wind shut down impact pile driving of monopiles if a NARW is sighted at any distance. On days with good visibility, shutdown may occur based on a NARW sighting entering or within the limit of the Level B harassment zone (4,684 m). While this mitigation measure will not necessarily minimize take by Level B harassment, it might reduce the duration and intensity of exposure above the Level B harassment isopleth.

Comment 9: The Commission argues that, if NMFS' intent is to minimize all impacts during impact pile driving, requiring South Fork Wind to monitor a 2,200-m clearance zone is inadequate given that the Level B harassment zone is 4,684 m. Further, the Commission asserts that a single vessel stationed a 2,200 m would not be sufficient to monitor the farther extents of the zones. The Commission claims that the range to the farthest extent would be 4,200 m based on the exclusion zone and more than 6,800 m based on the Commission's calculation of the size of the Level B harassment zone using DCSM.

Response: NMFS is requiring South Fork Wind to monitor the Level B harassment zone (4,684 m) prior to all impact pile driving, utilizing a combination of two PSOs located on the impact pile-driving vessel, two PSOs located on a dedicated vessel circling the pile-driving vessel at a radius of 2,200 m from the pile-driving vessel, and PAM capable of localizing baleen whale calls within a 5-km radius of the impact pile-driving vessel. The 2,200-m zone to which the Commission is referring is the minimum *visual* clearance zone for all baleen whale species other than the NARW (for which the clearance zone is undefined because any NARW observed by a PSO stationed on the pile-driving vessel or dedicated PSO vessel, regardless of distance, would trigger a delay in pile driving). The use of PAM to complement visual observations will be particularly important when visibility is limited to the minimum visual clearance zone rather than the full extent of the Level B harassment zone. Monitoring must begin 60 minutes prior to initiating pile driving; however, the clearance zones must be clear of marine mammals for 30 minutes before pile driving may commence. The final IHA adds and clarifies all zones and the mitigation and monitoring required to be implemented by South Fork Wind. It is unclear what method the Commission used to estimate a range of 4,200 m, or to what that range refers. Finally, as described above, NMFS does not adopt the use of DCSM to estimate or substantiate the modeled Level B harassment zone for impact pile driving, and is proceeding with 4,684 m as the range to the Level B harassment isopleth. Again, these ranges will be verified upon the onset of pile driving and the IHA contains measures that must be followed should SFV indicate ranges are larger than those predicted by the model.

Comment 10: The Commission states that the measure in the proposed IHA requiring PAM PSOs to review acoustic detections within 15 minutes of the original detection to verify whether a NARW has been detected is not real-time and would not preclude taking.

Response: PAM will occur in real-time, meaning a PAM PSO will be actively monitoring the hydrophones. However, in some cases, a PAM PSO cannot immediately identify a call as one from a NARW and requires some time to analyze the signal. Following the publication of the proposed IHA, South Fork Wind communicated to NMFS that PAM PSOs will be capable of reviewing and classifying detections within 5 minutes of the original detection, better approximating real-time monitoring of NARW presence. The final IHA and **Federal Register** notice have been revised to reflect this updated capability.

Comment 11: The Commission requested more specificity regarding South Fork Wind's proposed PAM plan (*i.e.*, minimum number, type, and location of hydrophones; bandwidth/sampling rate; estimated acoustic detection range; sensitivity of the hydrophones; detection software planned for use), noting that this information is necessary to ensure that South Fork Wind can detect, classify, and locate NARWs. ENGOs also requested that NMFS explain how the number and location of acoustic detection systems will be adequate to fully cover the area within the clearance and shutdown zones, particularly during times of high vessel traffic and development activity. Finally, the Commission recommends that NMFS consider how the direct strike pulses and reverberation from pile-driving activity could inhibit detection of marine mammal vocalizations, particularly those of NARWs.

Response: South Fork Wind is required to submit a detailed PAM plan to NMFS and BOEM for review and approval at least 90 days prior to the planned start of construction. The PAM plan must include sufficient information, including all equipment, procedures, and protocols to demonstrate that the monitoring and mitigation requirements included in the authorization will be met. Regarding the Commission's recommendation that NMFS consider the influence of direct strike pulses and reverberation on the ability to detect marine mammal vocalizations, NMFS agrees that

the multipaths will potentially spread the signal out and reduce the "quiet time" between pulses, thus increasing masking and making the detection process during pile driving more difficult. Additional signal processing methods will be required to enhance signal detection under such circumstances. The IHA is conditioned such that hydrophones will not be placed closer than 1 km from the pile being driven to minimize interference, and that the PAM system must be capable of detecting whales to implement mitigation within 5 km. The PAM plan submitted by South Fork Wind must be approved by NMFS prior to construction.

Comment 12: The Commission noted several perceived errors and omissions regarding hydroacoustic monitoring reporting requirements for impact pile driving, recommending that the following should be included: 1) hydrophone sensitivity, 2) water depth and sediment type(s) at the pile-driving location(s), 3) ranges to the Level A SEL_{cum} harassment isopleths, 4) fitting of the hydroacoustic data using DCSM and/or a simple cylindrical spreading model (following Waterproof (2020)), and 5) ambient noise spectra for diagnosing issues with hydrophone(s), and that the visibility metrics and ambient sound level measurements should be omitted from the reporting requirements.

Response: NMFS concurs with the Commission's recommendation that the hydroacoustic monitoring report should include 1) hydrophone sensitivity, water depth and sediment type at the pile location, ranges to the Level A harassment isopleths, and ambient noise spectra and 2) omit visibility metrics, and has adjusted those requirements in both the final IHA and in the **Monitoring and Reporting** section. In addition, for comparison of *in situ* data to sound fields modeled *a priori*, South Fork Wind plans to conduct SFV by measuring sound levels at multiple locations, (*e.g.*, nominal distances of 750; 1,500; 3,000; and 6,000 m). The SFV results will be fitted using a geometric spreading loss model, $\alpha \cdot \text{Log}(r)$, to provide the ability to predict sound levels at any range. The fitting process generates a site-dependent estimate of the transmission loss

coefficient, α, in the geometric spreading model. This differs from assuming cylindrical spreading loss, α=10, as is done in a Damped Cylindrical Spreading Model (DCSM). The DCSM includes a damping (absorption) term, which may be included when fitting the geometric model.

NMFS agrees with the Commission that ambient noise spectra should be reported and that visibility metrics are not a necessary reporting requirement, and has included these changes in the final IHA. However, despite the Commission's suggestion, NMFS supports collection of ambient sound measurements (as proposed by South Fork Wind), as these data contribute to the overall soundscape characterization within the WEA and provide context for detections of marine mammals during construction activities. NMFS has included this requirement in the final IHA.

Comment 13: The Commission claims that the Level B harassment zone presented here for vibratory pile driving is overestimated, that the modeled spectra provided in the Denes *et al.* (2020a) are inconsistent with spectra obtained from *in situ* measurements of similar activities (*e.g.*, Caltrans 2016; Illingworth and Rodkin 2017), and that the source level used to model the Level B harassment range for vibratory pile driving was too high. Using a simple transmission loss calculation and the estimated distance to the Level B harassment isopleth (36.8 km), the Commission estimates that the source level would be 173.5 dB re 1 µPa at 10 m and claims that this source level is higher than that used by NMFS for installation of smaller piles or sheet piles.

Response: The Commission appears concerned NMFS overestimated the Level B harassment zone for vibratory pile driving; however, any difference in the size of the modeled Level B harassment zone using their back-calculated source level (or any other lower source level) is minimally impactful given the very short period of activity (no more than 36 hours). NMFS recognizes that no model is exactly accurate and that *in situ* data demonstrate sound levels are not consistent both vertically and horizontally in the

water column or during the same activity (*e.g.*, installing 2 different piles of the same size/configuration). JASCO maintains, and NMFS agrees, that the spectra calculated using GRLWEAP (Denes *et al.*, 2020a) are fundamentally consistent with those provided by Illingworth and Rodkin (2017), as presented in the Caltrans reports (Caltrans 2016, 2020). The spectra calculated by JASCO are low frequency (*i.e.*, primary acoustic energy occurs below approximately 1 kHz), with peaks around the oscillation frequency of the vibratory hammer. This is approximately the same finding as Illingworth and Rodkin (2017), which showed that most of the primary acoustic energy occurs below approximately 2 kHz. The calculated levels near the source exceed the expected values of SPL 160-165 dB re 1 µPa measured at 10 m for sheet pile driving in the Caltrans report (2016, 2020) and as cited in NOAA's pile-driving worksheet tool (Caltrans 2012, 2015) (*https://media.fisheries.noaa.gov/2021-02/SERO%20Pile%20Driving%20Noise%20Calculator_for%20web.xlsx?null*). JASCO estimates an SPL of 180 dB re 1 µPa at 31 m, and consequently a range to 120 dB re 1µPa of approximately 36 km. JASCO recognized this as an overestimate but considered it acceptable because the source level measurements for vibratory driving of sheet piles cited in Caltrans (2012, 2015) come from only a few examples, and were obtained when setting the pile to a shallow depth before impact pile driving was used to drive the sheet pile to full desired depth. Only vibratory driving would be used for installation of sheet piles to construct the cofferdam for the South Fork Wind project. It is likely that sheet piles, and therefore the vibratory hammer, might encounter more resistance as the desired installation depth is approached at the cofferdam location compared to the examples included in the Caltrans report (2016, 2020). This increased resistance would require an increase in vibratory hammer energy, producing an elevated level of sound propagating from the installation site. NMFS agrees with this approach and, as such, no adjustments

were made to the Level B harassment zone (or Level A harassment zone) in the final IHA for vibratory driving of sheet piles.

Comment 14: The Commission claims that NMFS assumed that vibratory pile driving would occur on only two days, rather than a maximum of six days (up to three days each for installation and removal) specified elsewhere in the notice of the proposed IHA 86 FR 8490; February 5, 2021).

Response: This is an incorrect interpretation of the text. The total installation and removal will take up to six days to complete. Within that period, vibratory pile driving for the cofferdam is expected to occur for 18 hours to install the sheet piles and 18 hours to remove them, so a total of 2 days was used to estimate take. [86 FR 8490; February 5, 2021, p. 8533 states: Since NMFS expects that any exposures would be brief (no more than 3 hours per day for impact pile driving or 36 hours over 6 days for vibratory pile driving, and likely less given probable avoidance response). 36 hours over 6 days=a maximum of two 18-hour periods. p. 8521 states: Modeling of the Level A harassment exposures resulting from two 18-hour periods of vibratory pile driving and removal resulted in less than one exposure for all species for each month between October 1 and May 31. p. 8508 states: but the short-term duration (approximately 36 hours over 6 non-consecutive days, 18 hours each for installation and removal). p. 8491 states: Installation and removal of the cofferdam are each expected to take 1 to 3 days of vibratory pile driving.].

Comment 15: The Commission claims that NMFS did not increase the estimated Level B harassment takes for vibratory pile driving to an appropriate number, based on group size and frequency of occurrence in the project, for fin whales, sei whales, humpback whales, Atlantic white-sided dolphins, and common dolphins.

Response: Based on the best available scientific information and the large Level B harassment zone, NMFS agrees and has increased the number of takes by Level B

harassment for humpback whales, and common and Atlantic white-sided dolphins. NMFS reviewed reported group sizes for each species (DoN 2017; Smultea Sciences, 2020; CSA 2921; AMAPPS 2021), selected the largest group size reported for humpback whales (1.6; AMAPPS) and common dolphins (35; AMAPPS), multiplied group size by the number of potential days on which vibratory pile driving could occur (18 hours over 3 days for installation, 18 hours over 3 days for removal, total of 6 days), and rounded to the nearest whole number. This approach resulted in the following increases in Level B harassment takes: humpback whale (10) and common dolphins (210). Previous monitoring efforts in or near the South Fork Wind Lease Area reported that no Atlantic white-sided dolphins were sighted during surveys (Smultea Sciences, 2020; CSA 2021). However, AMAPPS (2021) reported sightings of Atlantic white-sided dolphins in the RI/MA WEA, with a peak group size of 50 during the summer. Based on this group size, NMFS has increased Level B harassment takes of Atlantic white-sided dolphins from 1 to 50. Finally, the Commission also recommended increasing take, by Level B harassment, of fin and sei whales incidental to vibratory pile driving. Exposure modeling resulted in exposures for each of 10 months (October-May; Table 19) for all species potentially impacted by vibratory pile driving. The amount of take proposed, by Level B harassment, of fin whales was based on the month (April) with the highest number of exposures (n=2). Of the remaining months, fin whale exposure estimates were zero (November, December, January, and February) and one (March and May). Given that the proposed amount of take was already conservatively based on modeled exposures in April and sightings of fin whales are generally more frequent in/near the Lease Area as compared to along the ECR and nearshore HDD site (e.g., Smultea Sciences, 2020), NMFS does not find that increasing take of fin whales, by Level B harassment, is warranted. Exposure modeling resulted in zero exposures of sei whales in all 10 months considered (Table 19). In addition, sei whale sightings are extremely rare throughout the project area, which

agrees with the generally offshore pattern of sei whale distribution (Hayes et al., 2021). Given the brief timeframe for cofferdam installation/removal, the low likelihood of sei whale occurrence in the project area during that brief timeframe, and the lack of exposures resulting from exposure modeling, NMFS does not find that increasing take of sei whales, by Level B harassment, is warranted.

Comment 16: The Commission notes that the input parameters necessary to estimate the Level A harassment zones for construction surveys using HRG equipment were not specified in the **Federal Register** notice for the proposed IHA (86 FR 8490; February 5, 2021). In addition, the Commission states that South Fork Wind specified incorrect frequencies in Table 13 of the IHA application for each functional hearing group's most sensitive frequency within the proposed operating frequencies of all impulsive sources, citing the example that South Fork Wind specified 1.5 kHz as the most sensitive frequency for all functional hearing groups within the 0.4-5 kHz operating frequency for the GeoMarine Geo-Source 400 tip sparker. The Commission states that most sensitive frequencies are 1.7 kHz for low-frequency (LF) cetaceans and 5 kHz for the other three functional hearing groups.

Response: NMFS recognizes that not all input parameters (*e.g.*, Weighting Factor Adjustments, WFAs) required to estimate Level A harassment zones were included in the notice for the proposed IHA; however, these values were included in the IHA application, which was available for review during the public comment period (please refer to the IHA application for more details on input parameters). The Commission notes that the frequencies in Table 13 of the application were incorrectly specified, and NMFS agrees. However, when the correct frequencies are applied, the resulting ranges to the Level A harassment isopleths are significantly smaller than the 500-m shutdown zone for NARWs and 100 m shutdown for all other species (excluding some delphinid species for which shutdown is waived). Further, NMFS has repeatedly indicated that the potential for Level

A harassment from marine site characterization surveys is not a realistic outcome regardless of implementation of mitigation measures such as shut down (see *Take Calculation and Estimation* section); therefore, identifying inputs into any Level A harassment model is not necessary.

Comment 17: The Commission notes that the ranges to Level A harassment isopleths in Table 12 of the notice of the proposed IHA (86 FR 8490, February 5, 2021) for high-frequency cetaceans are incorrect, according to their calculations, by a margin of tenths of a meter for all impulsive sources based on SEL_{cum} thresholds (ranges were reported as zero in the notice of the proposed IHA, but should have been reported as < 1), by a margin of 1.9 m for the AA triple plate S-boom based on SPL_{peak} (2.8 m versus 4.7 m, as indicated in the notice of the proposed IHA), and by a margin of tens of meters for the non-impulsive GeoPulse 5430 based on SEL_{cum} (97.7 m versus 36.5 m as indicated in the notice of the proposed IHA), assuming use of the User Spreadsheet and South Fork Wind's specified input parameters.

Response: NMFS appreciates the Commission's detailed comments regarding ranges to the Level A harassment isopleths for high-frequency cetaceans. NMFS has corrected the text in the *Take Calculation and Estimation* section to reflect that South Fork Wind estimated the range to the Level A harassment isopleth based on SEL_{cum} for the GeoPulse 5430 (36.5 m) following NMFS interim guidance (NMFS, 2019b), which accounts for beamwidth, water depth, and absorption (rather than using the User Spreadsheet). While there are minor inconsistencies between values calculated by NMFS and the Commission for the other ranges to the Level A harassment isopleths, the differences are inconsequential given that NMFS neither anticipates nor authorizes Level A harassment incidental to construction surveys. For the purposes of the exposure analysis, it was conservatively assumed that sparkers would be the dominant acoustic source for all survey days. Thus, the range to the isopleth corresponding to the threshold

for Level B harassment for sparkers (141 m), which is larger than any modeled range to the Level A harassment isopleth for any hearing group, was used as the basis of the take calculation for all marine mammals.

Comment 18: The Commission seeks clarification regarding why the exclusion zones for mid-frequency cetaceans (except sperm whales), and phocids are different between Table 26 in the **Federal Register** notice of the proposed IHA (86 FR 8490; February 5, 2021) and Table 2 of the proposed authorization.

Response: The zones being referenced in Table 26 of the notice of the proposed IHA are the Level A harassment zones for HRG survey activities, which are based on the calculated ranges, whereas the zones in Table 2 of the proposed authorization represent the clearance zones to be implemented during surveys. These zones are consistent with the clearance and shutdown zones listed in Table 26 of the notice of the proposed IHA (100 m).

Comment 19: The Commission notes that the Level B harassment zones for CHIRPS are inconsistent in Tables 12 and 26 of the **Federal Register** notice of the proposed IHA (86 FR 8490; February 5, 2021).

Response: The Level B harassment zones for CHIRPS have been corrected to 54 m in Table 28 of this notice.

Comment 20: The Commission recommends that NMFS publish a revised **Federal Register** notice and draft authorization with another 30-day comment period because it believes there were errors in the proposed IHA notice that prevented the public from fully understanding NMFS' proposed action and NMFS's preliminary findings are questionable given these perceived errors.

Response: NMFS does not agree with the Commission assertions and does not adopt the recommendation. Specifically, NMFS disagrees that the information presented in association with the proposed IHA was insufficient to make the relevant findings under

the MMPA. What the Commission claims are "inconsistencies, omissions, errors, and deficiencies" are, for the most part, differences of opinion on how available data should be applied to our analysis. For example, the Commission states that installing 16 monopiles, with one pile installed every other day, would take 31 rather than 30 days as specified in South Fork Wind's application and the **Federal Register** notice. Neither the IHA application nor the **Federal Register** notice state that monopiles would actually be installed every other day. Animal exposure modeling required a piling schedule within which to conduct animat modeling; therefore, two construction schedules were considered, one in which piles are installed every day and one in which piles are installed every other day. It is likely that neither of these absolute representative schedules will be adhered to during installation of the monopiles (*e.g.*, pile installation may occur on consecutive days if conditions allow, or might be interrupted by days of inclement weather or other mitigating circumstances, etc.). The 30-day timeframe for monopile installation was proposed by South Fork Wind in the IHA application and, therefore, included in the notice of the proposed IHA. Regardless of the detailed schedule, up to 16 monopiles will be installed, no more than one per day, over the course of the South Fork Wind construction project.

As described in responses to comments 1 and 3, a majority of the Commission's comments were centered around the recommendation to use a different, but not necessarily more accurate, acoustic model (*i.e.*, DCSM and associated spreadsheet tool, DCSiE (Heaney *et al.*, 2020)). NMFS does not agree that utilizing DCSM and the DCSiE spreadsheet tool would provide more appropriate acoustic propagation distances because the DCSM and DCSIE approach would include a simpler model of propagation (with limitations beyond 5 km from the acoustic source) that approximates some aspects of environmental interaction (namely absorption). NMFS believes that the well-tested, range-dependent propagation models based on solutions to the wave equation used by

JASCO (described in Denes *et al.*, 2020a) are more appropriate. Where we did agree that there was an error or that the Commission's logic was more appropriate to implement, we have made the recommended changes. However, the recommendations by the Commission we did adopt were predominately to either provide additional clarification or detail and do not provide additional conservation value or meaningfully influence any of the analyses underlying the necessary findings. NMFS strongly disagrees with the Commission's suggestion that NMFS' negligible impact and least practicable adverse impact determinations may be invalid, and we note that the Commission does not provide any information supporting this comment, whether NMFS retained the take numbers and mitigation requirements from the proposed IHA or adopted those recommended by the Commission. Since publication of the proposed IHA, NMFS included additional monitoring and mitigation measures, including multiple additions to the vessel strike avoidance requirements. In addition, the **Federal Register** notice for issuance of the final IHA includes installation of a casing pipe as an alternative to a cofferdam. Given the shorter installation time and fewer number of piles, potential impacts associated with installation of a casing pipe are anticipated to be equal to or less than those associated with installation of the cofferdam. Overall, these changes are not sufficient to lead NMFS to reach any other conclusions regarding the impact to marine mammals. For these reasons, NMFS is not republishing a notice of proposed IHA.

Comment 21: The Commission states that NMFS must provide consistent and informed guidance to the numerous industry operators that have submitted or soon will submit incidental take authorization applications for wind energy surveying, siting, and construction projects.

Response: NMFS appreciates the Commission recommendation and will consider developing broader/general guidance that allows for proper and consistent mitigation and monitoring during various stages of offshore wind development. NMFS will continue to

prioritize pre-application engagement with applicants seeking incidental take authorizations.

Comment 22: The Commission recommended that NMFS consider whether, in situations involving marine site characterization surveys using HRG equipment, IHAs are necessary. The Commission makes reference to comments on previously proposed IHAs for marine site characterization surveys, in which the Commission states that the small size of the Level B harassment zones, the various shutdown requirements, and BOEM's lease-stipulated requirements support the claim that NMFS should consider the Commission's recommendation. In addition, the Commission recommended that NMFS should evaluate whether take needs to be authorized for those sources that are not considered *de minimis*, including sparkers, and for which implementation of the various mitigation measures should be sufficient to avoid Level B harassment takes.

Response: NMFS thanks the Commission for its recommendation. However, as NMFS has noted previously to comments (*e.g.*, 85 FR 60424; September 25, 2020), NMFS has evaluated whether taking needs to be authorized for those sources that are not considered *de minimis*, including sparkers and boomers, factoring into consideration the effectiveness of mitigation and monitoring measures, and we have determined that implementation of mitigation and monitoring measures cannot ensure that all take can be avoided during all marine site characterization survey activities under all circumstances at this time. If and when we are able to reach such a conclusion, we will re-evaluate our determination that an incidental take authorization is warranted for these activities.

Comment 23: The ENGOs recommended that NMFS reduce the number of Level A harassment takes for large whales to as close to zero as possible and ensure zero Level A harassment takes of NARWs. The ENGOs feel that the number of individuals projected to experience permanent threshold shift (PTS), including humpback, minke, and endangered fin whales, is relatively high for a project comprising only 15 turbines.

Response: South Fork Wind has not requested, nor has NMFS authorized, incidental take by Level A harassment of NARWs. The mitigation and monitoring measures included in the IHA help ensure this level of harassment does not occur. The estimated Level A harassment exposures for humpback, minke, and endangered fin whales resulting from animal movement modeling are conservatively based on the maximum design scenario including one difficult-to-drive pile, the maximum densities across the proposed construction months, and a 24-hour accumulation period. This sophisticated model produces a reliable, but conservative, estimate of how many marine mammals may experience PTS incidental to the project. Although modeling does take into account the seasonal moratorium on impact pile driving of monopiles, it does not account for any additional mitigation. In addition, the proposed Level A harassment (in the form of PTS) take numbers, which are based on animal movement modeling, do not fully account for the likelihood that whales will avoid a stimulus (*i.e.*, aversion) when possible before the individual accumulates enough acoustic energy to potentially cause auditory injury. Any adjustments to the model considering mitigation or avoidance behavior are uncertain; therefore, to be conservative, NMFS is authorizing the amount of take, by Level A harassment (PTS), predicted by the model. Any Level A harassment would be expected to be in the form of slight PTS (*i.e.* minor degradation of hearing capabilities) which is not likely to meaningfully affect the ability to forage or communicate with conspecifics. Even absent mitigation, no serious injury or mortality from construction activities is anticipated.

Comment 24: The ENGOs recommended that NMFS require the seasonal prohibition on impact pile driving to be effective from December 1 through April 30.

Response: Since publication of the proposed IHA, South Fork Wind communicated to NMFS that construction activities will not commence until November 2022, rather than between April and May 2022 (as indicated in the proposed IHA).

Therefore, the period of effectiveness of the IHA is November 15, 2022, to November 14, 2023. In the final IHA, NMFS is requiring a seasonal restriction on impact pile driving of monopiles from December 1 through April 30, unless unanticipated delays due to weather or technical problems, notified to and approved by the Bureau of Ocean Energy Management (BOEM), arise that necessitate extending impact pile driving of monopiles into December. South Fork Wind's revised project schedule includes, as the first construction activity during the period of effectiveness of the IHA, installation of a cofferdam or casing pipe where the export cable conduit exits from the seabed to contain drilling returns and prevent the excavated sediments from silting back into the Horizontal Directional Drill (HDD) exit pit. Based on the seasonal restriction on monopile installation and South Fork Wind's revised construction schedule, monopile installation would not begin until May 2023. Therefore, the timeframe in which South Fork Wind would install monopiles is limited to May 1, 2023, through November 14, 2023.

Comment 25: The ENGOs recommended that NMFS take measures to minimize Level B harassment exposure of NARWs to noise from pile driving beyond the 5,000-m clearance zone by requiring stringent noise reduction and attenuation devices.

Response: While the clearance zone (using a combination of visual and acoustic observation) for NARWs is 5,000 m, NMFS is including measures to minimize exposure beyond that zone. For example, any observation of a NARW at any distance by PSOs on the pile-driving platform or dedicated PSO vessel will trigger a delay in impact pile driving. Because PSOs on the pile-driving platform will be equipped with enhanced vision capabilities (*e.g.* big eye binoculars), it may well be that NARWs are observed beyond 5,000 m on days with good visibility conditions. The final IHA clarifies that the minimum visibility zone to begin pile driving is 2,200 m and that PAM PSOs must confirm that there have been no PAM detections of NARWs out to 5,000 m prior to commencing pile driving (during the clearance period). The IHA does require noise

reduction such that the model results, assuming 10-dB attenuation, are not exceeded. If acoustic monitoring reveals greater than anticipated zone sizes, the IHA requires South Fork Wind to take additional noise mitigation measures to prevent further exceedance of the modeled zones. If all measures are exhausted and monitoring reveals South Fork Wind was not successful in meeting the modeled zones, harassment, minimum visibility, and shutdown zones will be expanded and monitoring enhanced.

Comment 26: The ENGOs recommended that if a NARW is visually or acoustically detected within the 5,000-m clearance zone, or visually detected at any distance from the pile at any time, that pile driving be shutdown, unless continued pile-driving activities are necessary for reasons of human safety or installation feasibility. In addition, they suggest that NMFS should consider expanding these same protections to other endangered species, as well as those currently experiencing a UME that are in the same functional hearing group as the NARW.

Response: NMFS agrees with the ENGOs that impact pile driving should be delayed or shutdown, if already initiated, if a NARW is sighted at any distance from the pile and, thus, NMFS included those conditions in the proposed IHA and has carried them over to the final authorization as well. South Fork Wind is required to delay pile driving if a NARW call is localized to a position within the 5,000-m clearance zone and, if pile driving has already commenced, South Fork Wind must shutdown pile driving if a NARW call is localized to a position within the 2,000-m PAM shutdown zone. NMFS has determined that the combination of a PAM shutdown zone that is larger than the Level A harassment zone for NARWs (1,621 m) and the requirement to shutdown if a NARW is sighted at any distance are sufficiently protective to prevent Level A harassment.

The ENGOs suggested that NMFS should also require a 5,000-m shutdown zone during monopile installation if other endangered species (*i.e.*, fin and sei whales) as well

as those currently experiencing a UME (*i.e.* humpback and minke whales), are detected visually or acoustically within the 5,000-m clearance zone specific to NARWs. NMFS is not authorizing *any* take by Level A harassment (*i.e.,* PTS) for NARWs; therefore, the shutdown requirements when a NARW is detected (visually or acoustically) must afford the greatest practicable protection to avoid any Level A harassment. NMFS is authorizing take by Level A harassment of fin, sei, and minke whales (one take for each species), although both the clearance (2,200 m) and shutdown zones (2,000 m) are hundreds of meters larger than the exposure-based modeled ranges to the Level A harassment isopleths for these species. Animal movement modeling resulted in the Level A harassment exposure of one fin whale and one minke whale; however, animal movement modeling does not account for mitigation measures or potential avoidance behavior and, as mentioned above, the shutdown zone is larger than the ranges to the Level A harassment isopleths for both fin (1,756 m) and minke whales (1,571 m). Although animal movement modeling resulted in zero Level A exposures of sei whales, South Fork Wind requested and NMFS is authorizing take, by Level A harassment, of one sei whale based on 1) rare observations of singleton sei whales in the Lease Area during previous monitoring effects (Kenney and Vigness-R,aposa, 2010; Smultea Sciences, 2020; AMAPPS 2021), and 2) difficulty distinguishing fin and sei whales at sea (observers sometimes report a sei/fin whale complex). NMFS is authorizing take, by Level A harassment, of 4 humpback whales based on the results of animal movement modeling, and the possibility that humpback whales might remain in the area between the shutdown zone (2,000 m) and the furthest extent of the Level A harassment zone (3,642 m), (assuming 10-dB attenuation) for a long enough timeframe to incur PTS.

If any large whale (including NARWs) enters the Level B harassment zone undetected or if visibility conditions limit visual monitoring to the minimum visibility zone, it is possible that individuals might be exposed to impact pile-driving noise

sufficient to cause behavioral effects rising to the level of take under the MMPA. NMFS expects those effects would be temporary in nature and unlikely to cause any perceptible longer-term consequences to individuals or populations.

While NMFS analyzed Level A harassment exposures as requested by South Fork Wind and authorized them as appropriate, NMFS finds that such exposures are unlikely given 1) the short duration of monopile installation (2-4 hours), 2) the fact that authorized take numbers do not account for mitigation measures, and 3) the potential for a whale's averse behavior in response to impact pile driving. Level B harassment of some smaller number of individuals as a subset of the overall stock is unlikely to result in any significant realized decrease in viability for the affected individuals, and thus would not result in any adverse impact to the stock as a whole. Accordingly, NMFS does not find it warranted to require shutdown if a fin, sei, humpback, or minke whale is detected between 2,000 m and 5,000 m of the pile.

Comment 27: The ENGOs stated that NMFS should provide more detail (both a written description and diagram of potential "blind spots" during monitoring) on how the secondary vessel will be deployed during the 60-minute clearance period (*e.g.*, vessel speed, configuration of PSOs on the vessel, etc.) to monitor the entire clearance zones as well as the 3,642-m Level A harassment zone for humpback whales and, if it is not possible to provide full coverage of the clearance zone for the full 60-minute period, the ENGOs recommended that NMFS require additional monitoring vessels and PSOs.

Response: South Fork Wind is required to visually monitor a minimum clearance zone with a 2.2-km radius from the pile-driving vessel, and to use a combination of visual and acoustic methods to ensure that a 5-km radius clearance zone is clear of NARWs prior to initiating pile driving. Further, on days when PSOs are able to observe beyond 5 km, any detection of a NARW by PSOs on the pile-driving and/or dedicated PSO vessels, regardless of distance, would trigger a delay in pile driving. Each of the two PSOs

deployed on the pile-driving vessel will be responsible for visually surveying 180 degrees (for a total of 360 degrees) out to a minimum of 2.2 km from the pile-driving vessel, the minimum visibility requirement for clearance to occur, thereby providing total visual coverage of the large whale clearance zone without any potential "blind spots." The PSOs on the pile-driving vessel will likely be positioned at a higher elevation above the waterline than the PSOs on the dedicated PSO vessel and will, therefore, have a range of vision well beyond 2.2 km on days with good visibility. The two additional PSOs deployed on the dedicated PSO vessel, surveying at a radius of 2.2 km from the pile-driving vessel, are expected to be positioned at an elevation above the waterline similar to PSOs on HRG vessels used in marine site characterization surveys. Each of these PSOs will also be responsible for surveying 180 degrees, with one PSO providing visual coverage between the dedicated PSO vessel and the pile-driving vessel (the 2.2-km clearance zone), and the second PSO visual monitoring the area beyond the 2.2-km clearance zone. Visibility conditions may, at times, prevent 100-percent visual coverage of the humpback Level A harassment zone beyond 2.2 km from the piling vessel; therefore NMFS is authorizing 4 takes, by Level A harassment, of humpback whales.

PSOs on board the pile-driving and dedicated PSO vessels will coordinate to the extent practicable to visually cover discrete zones while monitoring. The dedicated PSO vessel will travel at a maximum speed of 10 kts, allowing it to make a complete trip around the piling vessel at a distance of 2.2 km in one hour or less. The use of a real-time data collection platform, including the software program Mysticetus, will allow PSOs on the pile-driving vessel to see detections made by PSOs on the dedicated PSO vessel, and vice versa.

Comment 28: The ENGOs recommended that all project-associated vessels should adhere to a 10-kt speed restriction at all times, except in circumstances where the best

available scientific information demonstrates that whales do not use a particular area within the overall project area.

Response: South Fork Wind is required to operate all vessels at 10 kts or less when overlapping with a DMA and in any designated SMA. Further, if a vessel is operating faster than 10 kts, a dedicated observer is required to be onboard that vessel. While NMFS acknowledges that vessel strikes can result in injury or mortality, and that risk of vessel strike increases with speed, NMFS has analyzed the potential for ship strike resulting from South Fork Wind's activity and has determined that, based on the number and frequency of vessels South Fork Wind will be operating and the required mitigation measures specific to vessel strike avoidance included in the IHA, the potential for vessel strike is so low as to be discountable. These mitigation measures, most of which were included in the proposed IHA and all of which are required in the final IHA, include, but are not limited to the following requirements: 1) all vessel operators must comply with 10-kt (18.5 km/hour) or less speed restriction in any SMA while underway, 2) in the event that a DMA is established that overlaps with an area where a project-associated vessel would operate, that vessel, regardless of size, will transit that area at 10 kts (18.5 km/hour) or less, and 3) vessels of all sizes must operate port to port at 10 kts (18.5 km/hour) or less between November 1 and April 30, except while transiting inside Narragansett Bay or Long Island Sound. NMFS has determined that the ship strike avoidance measures in the IHA are sufficient to ensure the least practicable adverse impact on species or stocks and their habitat. Furthermore, NMFS is not aware of any documented vessel strikes involving vessels associated with offshore wind development, including vessels used for marine site characterization surveys (for which IHAs were issued by NMFS) during the survey activities themselves or while transiting to and from project sites.

Comment 29: The ENGOs recommended that NMFS require South Fork Wind to use the best commercially feasible technology and methods to minimize sound levels from pile driving. Specifically, they stated that NMFS should require a combination of noise mitigation systems to 1) obtain the greatest noise reduction and attenuation using technically and commercially feasible measures considering factors such as project design and seabed conditions, and 2) achieve no less than 10-dB SEL in combined noise reduction and attenuation, taking as a baseline, projections from prior noise measurements of unmitigated piles from Europe and North America.

Response: NMFS agrees with the ENGOs recommendation that South Fork Wind should use the best available technology to reduce acoustic impacts to marine mammals incidental to impact pile driving of monopiles. In the IHA application, South Fork Wind proposed to use a single BBC to attenuate noise produced during monopile installation. However, the final IHA requires that South Fork Wind use either a single BBC coupled with an additional noise mitigation device (*e.g.*, Hydro Sound Damper), or a dBBC to achieve measured ranges to the Level A harassment and Level B harassment isopleths that are equal to or less than those predicted by acoustic modeling, assuming 10-dB attenuation. NMFS has determined that this mitigation measure will help to ensure that take of marine mammals, including NARWs, is reduced to the level of least practicable adverse impact.

Comment 30: The ENGOs recommended that NMFS should require South Fork Wind to report all visual observations and acoustic detections of NARWs to NMFS or the Coast Guard as soon as possible and no later than the end of the PSO shift, and that South Fork Wind should also be required to immediately report an entangled or dead NARW to NMFS, the Marine Animal Response Team (1-800-900-3622) or the United States Coast Guard via one of several available systems (*e.g.* phone, app, radio).

Response: NMFS agrees with the recommendation that NARW detections, both visual and acoustic, should be reported as soon as possible. The IHA requires that if a NARW is observed at any time by PSOs or personnel on any project vessels, during any project-related activity or during vessel transit, South Fork Wind must report sighting information to the NMFS NARW Sighting Advisory System, the U.S. Coast Guard via channel 16, and the WhaleAlert app as soon as feasible but no longer than 24 hours after the sighting. We anticipate that most sightings will be reported by the end of the PSO shift as recommended by the ENGOs; however, we also recognize that communications at sea can sometimes be interrupted (*e.g.*, poor cellular or satellite service). Therefore, we are allowing the 24-hour maximum delay in reporting a sighting(s) (with the caveat they report a sighting as soon as feasible). If a NARW is detected via PAM, a report of the detection must be submitted to NMFS as soon as is feasible, but no longer than 24 hours after the detection. In addition, within 48 hours, metadata associated with the detection(s) must be submitted to the Northeast Passive Acoustic Reporting System (nmfs.pacmdata@noaa.gov). We note that given the gravity of a situation associated with the unauthorized take by ship strike, the IHA requires South Fork Wind to report any such taking to NMFS immediately, dedicating all resources to ensure that the incident is reported. Such dedication, including ceasing activities (as required if a ship strike occurs) is not necessary for a sighting or acoustic detection report. See the Mitigation section below for details. In addition, NMFS agrees with the recommendation that South Fork Wind should be required to immediately report a dead or entangled whale to NMFS, a Marine Animal Response Team, and the USCG, and has included this requirement in the final authorization.

Comment 31: The ENGOs and a commenter from the general public recommended that NMFS incorporate additional data sources into calculations of marine mammal density and take estimates. Similarly, RODA stated the NMFS' analyses should

rely on the best available data for estimating marine mammal take and developing robust mitigation measures, and that the impacts to NARWs be fully considered prior to the issuance of the IHA.

Response: Habitat-based density models produced by the Duke University Marine Geospatial Ecology Lab (MGEL; Roberts *et al.,* 2016, 2017, 2018, 2020) represent the best available scientific information concerning marine mammal occurrence within the U.S. Atlantic Ocean (more information, including the model results and supplementary information for each of those models, is available at *https://seamap.env.duke.edu/models/Duke/EC/*). Density models were originally developed for all cetacean taxa in the U.S. Atlantic (Roberts *et al.*, 2016). These models provided key improvements over previously available information, by 1) incorporating additional aerial and shipboard survey data from NMFS and other organizations collected over the period 1992-2014, 2) incorporating data from 60-percent more shipboard and 500-percent more aerial survey hours than did previously available models, (3) controlling for the influence of sea state, group size, availability bias, and perception bias on the probability of making a sighting, and (4) modeling density from an expanded set of 8 physiographic and 16 dynamic oceanographic and biological covariates. In subsequent years, certain models have been updated on the basis of availability of additional data as well as methodological improvements. In addition, a new density model for seals was produced as part of the 2017-18 round of model updates. Of particular note, Roberts (2020) further updated density model results for NARWs by incorporating additional sighting data and implementing three major changes: increasing spatial resolution, generating monthly estimates based on three periods of survey data, and dividing the study area into 5 discrete regions. Model Version 9 for NARWs was undertaken with the following objectives (Roberts 2020): 1) to account for recent changes to NARW distributions, the model should be based on survey data that extend through

2018, or later if possible. In addition to updates from existing collaborators, data should be solicited from two survey programs not used in prior model versions, including aerial surveys of an area overlapping the Massachusetts (MA) and RI/MA WEAs from 2011-2015 led by New England Aquarium (Kraus *et al.*, 2016), and continued from 2017-2018, and recent surveys of New York waters, either traditional aerial surveys initiated by the New York State Department of Environmental Conservation in 2017, or digital aerial surveys initiated by the New York State Energy Research and Development Authority in 2016, or both; 2) to reflect a view in the NARW research community that spatiotemporal patterns in NARW density changed around the time the species entered a decline in approximately 2010, consider basing the new model only on recent years, including contrasting "before" and "after" models that might illustrate shifts in density, as well as a model spanning both periods, and specifically consider which model would best represent NARW density in the near future; 3) to facilitate better application of the model to near-shore management questions, extend the spatial extent of the model farther in-shore, particularly north of New York; and 4) increase the resolution of the model beyond 10 km, if possible. All of these objectives were met in developing the Version 9 update to the NARW density model.

Accordingly, NMFS has determined that the Roberts *et al.* suite of density models represent the best available scientific information, and this determination was incorporated into NMFS' analysis for this IHA. NMFS' reliance on the best available scientific evidence in our analysis of potential impacts of the project on marine mammals and the development of take estimates further includes recent survey data. For example, where marine mammal sighting data collected by PSOs during marine site characterization surveys in or near the project area indicated that the potential for take may be higher than indicated by the modeled exposures, we adjusted take numbers accordingly, when appropriate. For NARWs, exposure modeling was based on the most

recent density data (Roberts 2020), which, as described above, incorporated more recent survey data (through 2018) and that for the first time included data from the 2011-2015 surveys of the MA and RI/MA WEAs (Kraus *et al.* 2016) as well as the 2017-2018 continuation of those surveys, known as the Marine Mammal Surveys of the Wind Energy Areas (MMS-WEA) (Quintana *et al.*, 2018). In addition, Pace (2021) describes that the stock abundance of NARW is lower than that considered when the proposed IHA was published; we have evaluated that new information and incorporated it into the final IHA. In developing the final IHA, NMFS also consulted the NARW sighting database, WhaleMap, which aggregates both visual and acoustic sighting information from 2010 to present day. Contributors to the database include the Department of Fisheries and Oceans Canada, Transport Canada, NOAA's Protected Species Branch, Woods Hole Oceanographic Institution/robots4whales, New England Aquarium, Center for Coastal Studies, Canadian Whale Institute, Mingan Island Cetacean Study, Ocean Tracking Network, Dalhousie University, University of New Brunswick, and Nick Hawkins Photography, making it an extensive database and useful tool in identifying spatial and temporal occurrence of whales as well as locations and timing of management actions such as implementation of DMAs.

NMFS invests heavily in conserving NARWs and, in analyzing the impacts to NARWs from project construction, has considered and leveraged the wealth of data collected by NOAA and partners to make appropriately conservative management decisions in consideration of our statutory authority under the MMPA. NMFS has applied the best available (and most recent) science and has made the determinations necessary to issue this IHA.

For future IHAs, NMFS will continue to review other recommended data sources that become available to evaluate their applicability in a quantitative sense (*e.g.*, to an estimate of take numbers) and, separately, to ensure that relevant information is

considered qualitatively when assessing the impacts of the specified activity on the affected species or stocks and their habitat. NMFS will continue to use the best available scientific information, and we welcome future input from interested parties on data sources that may be of use in analyzing the potential presence and movement patterns of marine mammals, including NARWs, in U.S. Atlantic waters.

Comment 32: The ENGOs recommended that NMFS should acknowledge the potential for take from vessel strikes and vessel noise. RODA similarly expressed concern that the vessel traffic associated with construction and operation of offshore wind farms may increase the risk of ship strike of NARWs, and suggests that NMFS should focus restrictions on increases in vessel traffic rather than vessel speed restrictions alone. In addition, RODA stated that increased vessel travel might contribute to elevated noise levels that will disrupt NARW behavior.

Response: South Fork Wind did not request authorization for take incidental to vessel strike during construction of South Fork Wind Farm. Nevertheless, as mentioned in the response to a previous comment, NMFS analyzed the potential for vessel strikes to occur during the construction phase of the project, and determined that the potential for vessel strike is so low as to be discountable. NMFS does not authorize any take of marine mammals incidental to vessel strike resulting from the construction phase of the project. If South Fork Wind strikes a marine mammal with a vessel, it would be in violation of the MMPA. This gives South Fork Wind a strong incentive to operate its vessels with all due caution and to effectively implement the suite of vessel strike avoidance measures called for in the IHA. South Fork Wind proposed a very conservative suite of mitigation measures related to vessel strike avoidance, including measures specifically designed to avoid impacts to NARWs. Section 4(d) in the IHA contains a suite of non-discretionary requirements pertaining to ship strike avoidance, including vessel operation protocols and monitoring. Since publication of the proposed IHA, NMFS included several new vessel

strike avoidance measures that further reduce the likelihood of take incidental to vessel strike (see **Changes from Proposed IHA to Final IHA**). Construction of the project will likely be based out of ProvPort, RI or Port of New London, CT, both of which require a 50-60 mile one-way trip by vessel to the Lease Area. South Fork Wind has indicated that during construction, the number of crew transfer vessel transits will be limited to 20 per month. To date, NMFS is not aware of any wind industry vessel (*e.g.*, marine site characterization survey vessel) reporting a ship strike. When considered in the context of the low overall probability of any vessel strike by South Fork Wind vessels, given the limited additional project-related vessel traffic relative to existing traffic in the project area, the comprehensive visual and PAM monitoring required in transit routes, and that construction would occur during the time of year when NARW density is lowest, NMFS believes these measures are sufficiently protective to avoid ship strike; thus, we did not authorize take from ship strike. These measures are described fully in the **Mitigation** section below, and include, but are not limited to: training for all vessel observers and captains, daily monitoring of the NARW Sighting Advisory System, WhaleAlert app, and USCG Channel 16 for situational awareness regarding NARW presence in the project area (including transit corridors), communication protocols if whales are observed by any South Fork Wind personnel, vessel operational protocols should any marine mammal be observed, and visual and passive acoustic monitoring to clear transit routes of NARWs.

The potential impacts of overall increases in the amount of vessel traffic related to OSW development, which is separate from the analysis of the potential for vessel strike during South Fork Wind's construction phase under the final authorization, were addressed in BOEM's EIS for the South Fork Wind project, which can be found here: *https://www.boem.gov/renewable-energy/state-activities/south-fork*. In summary, BOEM determined that it is likely that mobile marine mammals would avoid behavioral disturbance from exposures like those resulting from vessel noise, meaning that the

duration of exposure to noise from slow-moving, or closely clustered and stationary construction vessels would be limited. Moreover, a substantial portion of construction vessel activity would occur in an area having high existing levels of vessel traffic. In these areas, construction vessel noise would contribute to, but may not substantially alter, ambient noise generated by existing large vessel traffic in the vicinity.

As described above, South Fork Wind estimates that 20 crew transfer vessel transits per month will be required. While some individual marine mammals may exhibit short-term behavioral responses, and given the possibility that elevated background noise from vessels and other sources could interfere with the detection or interpretation of acoustic cues among NARW conspecifics, brief exposures to one or two South Fork Wind vessels transporting crew between the Lease Area and a nearby port would be unlikely to disrupt behavioral patterns in a manner that would rise to the level of take.

Comment 33: The ENGOs and a commenter from the general public recommended that NMFS analyze cumulative impacts to NARWs and other endangered and protected marine mammals species and stocks as part of the take estimation and permitting process, and suggest that NMFS advance a programmatic incidental take regulation for offshore wind development activities that takes into account risks from other sectors.

Response: The ENGOs conflate the requirements of the MMPA and NEPA in their contention that NMFS must analyze the cumulative impacts from multiple proposed wind development activities on NARWs and other endangered and protected species and stocks, and that appropriate mitigation must be prescribed to mitigate those cumulative impacts. Neither the MMPA nor NMFS' codified implementing regulations specifically call for consideration of impacts on marine mammals and their habitat from activities other than those specified in the request for authorization. The preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989) states in response to

comments that the impacts from other past and ongoing anthropogenic activities are to be incorporated into the negligible impact analysis via their impacts on the baseline. Consistent with that direction, NMFS has factored into its negligible impact analysis the impacts of other past and ongoing anthropogenic activities via their impacts on the baseline (*e.g.*, as reflected in the density/distribution and status of the species, population size and growth rate, and other relevant stressors). Section 101(a)(5)(D) of the MMPA requires NMFS to modify, suspend, or revoke the IHA if it finds that the activity is having more than a negligible impact on the affected species or stocks of marine mammals. NMFS will closely monitor baseline conditions before and during the period when the IHA is effective and will exercise this authority if appropriate. Section 101(a)(5)(D) of the MMPA requires NMFS to make a determination that the take incidental to a "specified activity," as opposed to other activities not specified in the request for an IHA, will have a negligible impact on the affected species or stocks of marine mammals. NMFS' implementing regulations require applicants to include in their request a detailed description of the specified activity or class of activities that can be expected to result in incidental taking of marine mammals. 50 CFR 216.104(a)(1). Thus, the "specified activity" for which incidental take coverage is being sought under section 101(a)(5)(D) is generally defined and described by the applicant. Here, South Fork Wind was the applicant for the IHA, and NMFS is responding to the specified activity as described in their application (and making the necessary findings on that basis). Through the response to public comments in the 1989 implementing regulations, we also indicated (1) that NMFS would consider cumulative effects that are reasonably foreseeable when preparing a NEPA analysis and (2) that reasonably foreseeable cumulative effects would also be considered through the section 7 consultation for ESA-listed species. In this case, cumulative impacts have been adequately addressed under NEPA in BOEM's Environmental Impact Statement regarding South Fork Wind's

proposed project. NMFS is a cooperating agency under NEPA on that EIS and has adopted the Final Environmental Impact Statement (FEIS) for purposes of issuing the IHA to South Fork Wind. In addition, NMFS was a signatory to the associated Record of Decision issued on November 24, 2021. Separately, NMFS engaged in intra-agency consultation under section 7 of the ESA. The resulting Biological Opinion, issued October 1, 2021, determined that NMFS' action of issuing the IHA is not likely to adversely affect listed marine mammals or adversely modify their critical habitat. The Biological Opinion considered activities both within (related to construction) and outside (*e.g.*, operation and decommissioning) the scope of NMFS' IHA and included Terms and Conditions aimed at reducing the potential impacts of the project on marine mammals, including NARWs.

With respect to the recommendation that NMFS advance programmatic incidental take regulations for offshore wind development that take into account risks from other sectors, NMFS may issue regulations upon request. To date, neither the offshore wind industry nor BOEM has expressed interest in applying for such regulations. We note that the footnote the ENGOs provided in the letter including this comment cites the request to BOEM for a programmatic EIS. Again, it appears the ENGOs are conflating the NEPA and MMPA processes. NMFS does agree with the ENGOs that consistency in mitigation measures, where appropriate, provides efficiencies and helps to ensure adequate measures are being prescribed. To this end, NMFS is working on developing best management practice guidelines that will assist NMFS in developing mitigation measures common to all offshore wind IHAs.

Comment 34: The ENGOs recommended that NMFS avoid describing potential changes resulting from offshore wind development as "beneficial," as it is unclear what implications these changes may have on the wider ecosystem, and instead use terminology such as "increase," "decrease," and "change."

Response: In the proposed IHA notice, NMFS identified that impacts from the permanent structures (*i.e.,* WTGs and OSS) on marine mammal habitat may be beneficial as a result of increased presence of prey due to the WTGs (and OSS) potentially acting as artificial reefs (Russell *et al.*, 2014). However, we recognize that the long-term impact from foundation presence is outside the scope of the effective period of the IHA and that this analysis is more appropriate in the context of the ESA consultation and NEPA analysis as it relates to marine mammal habitat. We agree that the long-term ecosystem effects from offshore wind development in the Northwest Atlantic are still being evaluated and that those ecosystem effects are likely to be complex. Thus, while we acknowledge that there is currently insufficient information to draw a conclusion regarding longer-term impacts to marine mammals, we agree with the commenters that the term "beneficial" should be avoided when describing potential outcomes of offshore wind development for marine mammals.

Comment 35: The ENGOs recommended that NMFS prohibit extensions of any 1-year authorizations through a truncated 15-day comment period as it is contrary to the MMPA. A member of the general public echoed this concern and suggested that there is not adequate time in the review process to comment on the proposed IHA or any potential renewal IHA.

Response: NMFS did not include language in the final IHA for the South Fork Wind project related to renewal. While this does not necessarily preclude a Renewal IHA, we think a Renewal IHA is unlikely in this case, given the potential for changes over the next three years that could affect our analyses. However, NMFS' IHA renewal process meets all statutory requirements. In prior responses to comments about IHA renewals (*e.g.*, 84 FR 52464; October 02, 2019 and 85 FR 53342, August 28, 2020), NMFS has explained how the renewal process, as implemented, is consistent with the statutory requirements contained in section 101(a)(5)(D) of the MMPA, provides

additional efficiencies beyond the use of abbreviated notices and, further, promotes NMFS' goals of improving conservation of marine mammals and increasing efficiency in the MMPA compliance process. Therefore, we intend to continue implementing the renewal process. The notice of the proposed IHA published in the **Federal Register** on February 5, 2021 (86 FR 8490) made clear that the agency was seeking comment on both the initial proposed IHA and the potential issuance of a renewal for this project. Because any renewal is limited to another year of identical or nearly identical activities in the same location or the same activities that were not completed within the 1-year period of the initial IHA, reviewers have the information needed to effectively comment on both the immediate proposed IHA and a possible 1-year renewal, should the IHA holder choose to request one. While there would be additional documents submitted with a renewal request, for a qualifying renewal these would be limited to documentation that NMFS would make available and use to verify that the activities are identical to those in the initial IHA, are nearly identical such that the changes would have either no effect on impacts to marine mammals or decrease those impacts, or are a subset of activities already analyzed and authorized but not completed under the initial IHA. NMFS would also need to confirm, among other things, that the activities would occur in the same location; involve the same species and stocks; provide for continuation of the same mitigation, monitoring, and reporting requirements; and that no new information has been received that would alter the prior analysis. The renewal request would also contain a preliminary monitoring report in order to verify that effects from the activities do not indicate impacts of a scale or nature not previously analyzed. The additional 15-day public comment period provides the public an opportunity to review these few documents, provide any additional pertinent information, and comment on whether they think the criteria for a renewal have been met. Between the initial 30-day comment

period on these same activities and the additional 15 days, the total comment period for a renewal is 45 days.

In addition to the IHA renewal process being consistent with all requirements under section 101(a)(5)(D), it is also consistent with Congress' intent for issuance of IHAs to the extent reflected in statements in the legislative history of the MMPA. Through the provision for renewals in the regulations, description of the process and express invitation to comment on specific potential renewals in the Request for Public Comments section of each proposed IHA, the description of the process on NMFS' website, further elaboration on the process through responses to comments such as these, posting of substantive documents on the agency's website, and provision of 30 or 45 days for public review and comment on all proposed initial IHAs and Renewals respectively, NMFS has ensured that the public is "invited and encouraged to participate fully in the agency's decision-making process" as Congress intended.

*Comment 3*6: The ENGOs recommended that NMFS work with relevant experts and stakeholders towards developing a robust and effective near real-time monitoring and mitigation system for NARWs and other endangered and protected species (*e.g.*, fin, sei, minke, and humpback whales) during offshore wind development.

Response: NMFS is generally supportive of this concept. A network of near real-time baleen whale monitoring devices are active or have been tested in portions of New England and Canadian waters. These systems employ various digital acoustic monitoring instruments, which have been placed on autonomous platforms including slocum gliders, wave gliders, profiling floats, and moored buoys. Systems that have proven to be successful will likely see increased use as operational tools for many whale monitoring and mitigation applications. A recent report published by NMFS summarizes a workshop NMFS convened to address objectives specifically related to monitoring NARWs and presents the Expert Working Group's recommendations for a comprehensive monitoring

strategy to guide future analyses and data collection ("Technical Memorandum NMFS-OPR-64: North Atlantic Right Whale Monitoring and Surveillance: Report and Recommendations of the National Marine Fisheries Service's Expert Working Group," which is available at: *https://www.fisheries.noaa.gov/resource/document/north-atlantic-right-whale-monitoring-and-surveillance-report-and-recommendations*). Among the numerous recommendations found in the report, the Expert Working Group encouraged the widespread deployment of auto-buoys to provide near real-time detections of NARW calls that visual survey teams can then respond to for collection of identification photographs or biological samples. Similar approaches utilizing real-time or archival PAM could be utilized to monitor other marine mammal species throughout the life cycles of offshore wind farms.

Comment 37: For comments and recommendations on high-resolution geophysical survey activities, the ENGOs directed NMFS to their letter submitted on September 9, 2020, regarding NMFS' failure to adequately protect endangered and protected marine mammals during marine site characterization surveys required for offshore wind development.

Response: NMFS refers the ENGOS to the **Federal Register** notice 85 FR 63508 (October 8, 2020) for previous responses to the ENGOs' previous letter.

Comment 38: The ENGOs recommended that NMFS coordinate with BOEM to establish and fund a robust, long-term scientific plan to monitor the effects of offshore wind development on marine mammals and other species before, during, and after large-scale commercial projects are constructed.

Response: NMFS appreciated the ENGOs' recommendation and will continue working with BOEM to develop strategies for monitoring the impacts of offshore wind development on protected species.

Comment 39: RODA expressed concern about potential negative impacts (*i.e.*, increased restrictions or other constraints) to Atlantic fisheries, local fisherman, and coastal communities resulting from any potential adverse impacts to NARWs and other protected species from offshore wind construction projects, noting that impacts on the fishing industry were not addressed in the proposed IHA.

Response: The socio-economic impacts of the South Fork Wind's activities are evaluated in the Final Environmental Impact Statement (FEIS) prepared by BOEM to assess the effects of construction and operation of the project, and which NMFS adopted to support the issuance of the IHA. However, neither the MMPA nor our implementing regulations require NMFS to analyze impacts to other industries (*e.g.*, fishermen) or coastal communities from issuance of an ITA. In order to issue an ITA, Sections 101(a)(5)(A) and 101(a)(5)(D) of the MMPA require NMFS to make a determination that the take incidental to a ''specified activity'' will have a negligible impact on the affected species or stocks of marine mammals, and will not result in an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses. NMFS has made the required determinations.

Comment 40: RODA expressed concern that the presence of offshore wind turbines may impact low altitude aerial surveys conducted by NOAA/NMFS to monitor protected species, including NARWs, as the height of the turbines would exceed the survey altitude.

Response: NMFS has determined that offshore wind development projects in the Northeast will impact several NEFSC surveys, including the aerial surveys for protected species. NEFSC has developed a federal survey mitigation program to mitigate the impacts to these surveys, and is in the early stages of implementing this program. However, this impact is outside the scope of analysis related to issuance of take incidental to the specified activity under the MMPA.

Comment 41: RODA stated that offshore wind site characterization surveys using HRG equipment could result in long-term and high-intensity impacts on marine mammals. In addition, RODA questions the efficacy of mitigation measures prescribed for such surveys, stating that it is presumptive to assume that mitigation measures are sufficient to eliminate adverse impacts to marine mammals and guarantee that no NARWs will be harmed during site characterization surveys.

Response: This IHA does not cover site characterization surveys – nevertheless, the construction surveys covered similarly utilize HRG equipment. RODA provides no evidence that site characterization surveys could result in long-term and high-intensity impacts on marine mammals, and that NARWs could be harmed during these surveys. The surveys utilizing HRG equipment SFEC (construction surveys) that will be conducted under the South Fork Wind IHA are specifically to assess the inter-array and export cables during construction of the SFWF, are relatively small scale (*i.e.*, no more than 60 days of survey activities), and use HRG equipment with small associated Level A harassment and Level B harassment zones (maximum of 141 m for Level B harassment). Both the clearance and shutdown zones for NARWs are more than three times the size of the Level B harassment zone (*i.e.*, 500 m), making it unlikely that NARWs would even experience Level B harassment from surveys, let alone more significant or long-term impacts. In contrast to RODA's comment, the Commission, the agency charged with advising federal agencies on the impacts of human activity on marine mammals, has questioned in its comments whether incidental take authorizations are even necessary for surveys utilizing HRG equipment (*i.e.*, take is unlikely to occur).

BOEM (2021a) reviewed underwater noise levels produced by the available types of HRG survey equipment as part of a programmatic biological assessment for this and other activities associated with regional offshore wind energy development. NMFS (2021) concurred with BOEM's determination that planned marine site characterization

survey activities using even the loudest available equipment types would be unlikely to injure or measurably affect the behavior of ESA-listed marine mammals. The rationale supporting this conclusion also applies to non-listed marine mammal species. Specifically, the noise levels produced by HRG survey equipment are relatively low, meaning that an individual marine mammal would have to remain very close to the sound source for extended periods to experience auditory injury. This type of exposure is unlikely as the sound sources are continuously mobile and directional (*i.e.*, pointed at the bottom). Along those lines, on June 29, 2021, NMFS GARFO concluded ESA consultation with BOEM and NMFS, finding that marine site assessment surveys using HRG equipment similar to that used by the surveys planned under this South Fork Wind IHA, may effect, but are not likely to adversely affect, ESA-listed marine mammals provided the project design criteria (PDC) and best management practices (BMP) proposed by BOEM are incorporated. NMFS has included those PDCs and BMPs in South Fork Wind's IHA, including the use of protected species observer (PSO) monitoring of species-specific clearance zones around specified HRG equipment (*i.e.,* boomers, sparkers, and Chirps), and mandatory shutdown procedures to further minimize exposure risk. While individual marine mammals may be exposed to marine site characterization survey noise sufficient to cause behavioral effects rising to the level of take under the MMPA, those effects would be temporary in nature and unlikely to cause any perceptible longer-term consequences to individuals or populations. Upon request, NMFS has conservatively issued take, by Level B harassment, incidental to construction surveys using HRG equipment.

Comment 42: RODA expressed interest in understanding the outcome if the number of actual takes exceed the number authorized during construction of an offshore wind project (*i.e.*, would the project be stopped mid-construction or mid-operation), and

how offshore wind developers will be held accountable for impacts to protected marine species such that impacts are not inadvertently assigned to fishermen.

Response: It is important to recognize that an IHA does not authorize the activity but authorizes take of marine mammals incidental to the activity. As described in condition 3(b) and (c) of the IHA, authorized take, by Level A harassment and Level B harassment only, is limited to the species and numbers listed in Table 1 of the final IHA, and any taking exceeding the authorized amounts listed in Table 1 is prohibited and may result in the modification, suspension, or revocation of the IHA. As described in condition 3(f), if an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has not been met, is observed entering or within the Level B harassment zone (construction surveys) or clearance zone (both impact and vibratory piles driving), HRG acoustic sources and pile-driving activities must be shut down immediately (when technically feasible as described under condition 4(a)(ix)(1) of the final IHA). Pile driving and reinitiation of HRG acoustic sources must not resume until the animal has been confirmed to have left the relevant clearance zone or the observation time (as indicated in conditions 4(a)(xi)(2), 4(b)(i)(6)), and 4(c)(i)(4) of the final IHA) has elapsed with no further sightings.

It is unclear why RODA would be concerned that impacts would be "inadvertently assigned" to fishermen. Fishing impacts generally center on entanglement in fishing gear, which is a very acute, visible, and severe impact. In contrast, the pathway by which impacts occur incidental to construction is primarily acoustic in nature. Regardless, any take beyond that authorized is unlawful. If the authorized takes were exceeded, but the project could proceed without additional take of marine mammals, it would be lawful. It is BOEM's responsibility as the permitting agency to make decisions regarding ceasing the project. If the case suggested by RODA does occur, NMFS would

work with BOEM and South Fork Wind to determine the most appropriate means by which to ensure compliance with the MMPA.

Comment 43: A commenter from the general public suggested that there is a lack of baseline auditory physiology data and adequate conservation metrics for sea turtles, finfish, and other marine species in the project area. The commenter correctly noted that the mitigation measures included in the proposed IHA do not include protections for sea turtles.

Response: Under the MMPA, NMFS is charged with analyzing the impacts from the specified activity to marine mammals and their habitat, including their prey (*e.g.*, fish and invertebrates), and to prescribe the permissible means of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat. In the *Effects to Prey* section of the notice of the proposed IHA (84 FR 8690, February 5, 2021), NMFS provides a summary and discussion of the ways noise produced by construction activities might impact fishes. The potential effects of noise on fishes depends on the overlapping frequency range, distance from the sound source, water depth of exposure, and species-specific hearing range, anatomy, and physiology. Key impacts to fishes may include behavioral responses, hearing damage, barotrauma (pressure-related injuries), and mortality. However, the most likely impact to fishes from impact and vibratory pile-driving activities in the project areas would be temporary avoidance of the area. The duration of fish avoidance of an area is unknown, but given the relatively short duration of vibratory pile driving (18 hours each for installation and removal), and the small number of monopiles planned for installation, NMFS anticipates a rapid return to normal recruitment, distribution, and behavior. In general, impacts to marine mammal prey species are expected to be minor and temporary.

Because sea turtles are not marine mammals, no protections are afforded to them under the MMPA. However, we refer the commenter to NMFS' Biological Opinion, issued

October 1, 2021. The Biological Opinion, issued pursuant to the ESA, contains an analysis on the impacts to ESA-listed fish and all sea turtles (as all sea turtle species are listed as endangered or threatened under the ESA). Impacts to non-listed fishes may be found in BOEM's Final EIS for the project, issued August 20, 2021, and found here: *https://www.boem.gov/renewable-energy/state-activities/south-fork*

Comment 44: A commenter from the general public identified several scientific journal articles that discuss the diving physiology of marine mammals, and stated that NMFS should consider this information as it relates to potential avoidance behavior marine mammals might demonstrate as a result of impact pile driving.

Response: NMFS used the best available science in developing its impact analysis and making the findings required to issue the requested IHA. The proposed IHA notice acknowledges avoidance as a potential response of a marine mammal when exposed to noise from project construction and identifies that such a response may reduce the potential of more severe impacts such as PTS. While the commenter was not specific about how NMFS should consider the suggested literature related to diving behavior, the Level A Harassment exposure estimates modeled by JASCO incorporated known dive behavior via animat modeling. However, NMFS has found that incorporating a behavior such as avoidance into an exposure model is extremely complex and contains a high degree of uncertainty. For this reason, the exposure modeling, and resulting take, do not consider avoidance behavior. NMFS reviewed the references provided by the commenter and determined that that the information contained therein was not sufficient to lead NMFS to reach any other conclusions regarding the impacts of pile driving on marine mammals.

Comment 45: A commenter from the general public stated that the proposed IHA would have benefited from NMFS' consideration of input from public comments on the DEIS and subsequent corrections in BOEM's Final Environmental Impact Statement

(FEIS), which assesses the physical, biological, and social/human impacts of the South Fork Wind project and all reasonable alternatives.

Response: NMFS' proposal to issue an IHA under the MMPA to authorize the taking of marine mammals incidental to South Fork Wind's in-water construction activities was a major federal action for purposes of the National Environmental Policy Act (NEPA), necessitating preparation of an appropriate level NEPA document. NMFS chose to satisfy this obligation by actively working with BOEM as a cooperating agency on the Draft Environmental Impact Statement (DEIS) and Final Environmental Impact Statement (FEIS) for the South Fork Wind offshore wind project. Once the FEIS was completed, NMFS independently evaluated it and determined the FEIS was sufficient to satisfy NMFS' independent NEPA responsibilities. NMFS drafted a memorandum for the record documenting its rationale for adopting BOEM's FEIS. NMFS then signed a Joint Record of Decision (ROD) in which it selected the alternative of issuing the IHA to South Fork Wind, explained the factors it considered in doing so, and specified the mitigation measures that would be imposed.

Changes from Proposed IHA to Final IHA

In the final IHA, NMFS Office of Protected Resources (OPR) adopted the Terms and Conditions of the October 2021 Biological Opinion for the South Fork Offshore Energy Project, the August 2021 Programmatic Consultation on marine site assessment surveys, and made other modifications as a result of public input on the proposed IHA, which resulted in changes to mitigation and monitoring measures from proposed to final IHA. NMFS provides a summary here, and the changes are also described in the specific applicable sections below (*e.g.*, **Mitigation**). A complete list of final measures may be found in the issued IHA (available at *https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable*).

Please note that since publication of the notice of the proposed IHA, NMFS has changed terminology from exclusion zone to shutdown zone to clarify the mitigation action to be taken when a marine mammal enters this zone. In addition, in order to distinguish surveys using HRG equipment to obtain a baseline assessment of seabed, ecological, and archeological conditions within the footprint of future offshore wind development (marine site characterization) from those surveys planned under this IHA (also using HRG equipment) to assess the inter-array and export cables throughout construction of the SFWF and SFEC, NMFS has changed terminology from HRG surveys to construction surveys.

Since publication of the proposed IHA, South Fork Wind communicated to NMFS that construction activities will not commence until November 2022, rather than between April and May 2022 (as indicated in the proposed IHA). Therefore, the period of effectiveness of the IHA is November 15, 2022 to November 14, 2023.

In addition to the seasonal restriction on impact pile driving of monopiles from January 1 through April 30 included in the proposed IHA, the final IHA specifies that impact pile driving of monopiles must not occur in December unless an unanticipated delay due to weather or technical problems, notified to and approved by BOEM, arises that necessitates extending impact pile driving of monopiles through December.

After further consideration, NMFS modified several zone sizes associated with monitoring and mitigation measures to provide additional protection for NARWs. The final IHA includes the condition that any large whale visually observed by a PSO within 2,000 m, or as modified based on SFV measurements, of the impact pile-driving vessel that cannot be identified to species must be treated as if it were a NARW for clearance and shutdown purposes. The distance has been increased from 1,000 m (included in the proposed IHA) to 2,000 m to align with the large whale shutdown zone. Similarly, the distance within which PSOs must treat an unspecified large whale as a NARW during

vibratory pile driving has been increased from 1,000 m to 1,500 m for the same reason. In the final IHA, NMFS has defined the minimum visibility zone, or the area over which PSOs must be able to clearly observe marine mammals to begin the clearance process, as 2.2 km. In addition, NMFS has clarified that the 2.2 km large whale clearance zone included in the notice of proposed IHA (Table 24) is the minimum *visual* clearance zone (*i.e.*, the zone that must be both fully visible and clear of NARWs and other large whales for 30 minutes immediately prior to commencing impact pile driving of monopiles)—beyond that distance, PAM, in conjunction with visual monitoring (recognizing the visibility limitations under certain conditions), must be used to confirm that the 5 km NARW clearance zone is clear of NARW's and other large whales prior to commencing impact pile driving of monopiles.

Since publication of the proposed IHA, South Fork Wind communicated to NMFS that the PAM system will be designed such that the PAM PSO will be capable of reviewing acoustic detections within 5 minutes of the original detection, rather than 15 minutes (as indicated in the proposed IHA), to determine if a NARW was detected. This reduced evaluation time provides improved support for near real-time mitigation actions, should they be required. While the proposed IHA required a PAM PSO to have 75-percent confidence that a vocalization originated from a NARW to call for a delay or shutdown of impact pile driving of monopiles, the final IHA only requires that a PAM PSO categorize a call as having a probable (or greater) likelihood of originating from a NARW (scale: no, possible, probable, yes). In addition, South Fork Wind is required to communicate detections of all marine mammals detected at any distance (*i.e.*, not limited to the 5 km Level B harassment zone) to visual PSOs for situational awareness. Finally, the final IHA now specifies that the PAM system(s) must not be placed closer than 1 km to the pile being driven.

The final IHA includes several additional vessel strike avoidance measures to provide enhanced protection for NARWs. South Fork Wind must use available sources of information on NARW presence, including 1) daily monitoring of the Right Whale Sightings Advisory System, 2) consulting the WhaleAlert app, and 3) monitoring of Coast Guard VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas (DMAs), to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with NARWs. This measure was not included in the proposed IHA but affords increased protection of NARWs by raising awareness of NARW presence in the area through monitoring efforts outside of South Fork Wind's efforts. In addition, whenever multiple project-associated vessels (*e.g.*, construction survey, crew transfer) are operating concurrently, any visual observations of ESA-listed marine mammals must be communicated to PSOs and/or vessel captains associated with other vessels to increase situational awareness. While the proposed IHA only required vessels greater than or equal to 65 ft (19.8 m) to immediately reduce speed to 10 kts or less when a NARW is sighted at any distance by the observer or anyone on the underway vessel (or any other large whale, mom/calf pair, or large assemblage of non-delphinoid cetaceans are observed near (within 100 m) of an underway vessel), the final IHA includes vessels of all sizes in this requirement. The final IHA requires that confirmation of marine mammal observer training (including an understanding of the IHA requirements) must be documented on a training course log sheet and reported to NMFS for those dedicated visual observers required on vessels that are traveling over 10 knots. In addition, NMFS now requires that when a marine mammal is observed during vessel transit, the following data must be collected: time, date and location (latitude/longitude); the vessel's activity, heading and speed; sea state, water depth and visibility; marine mammal identification to the best of the observer's ability (*e.g.*, NARW, whale, dolphin, seal); initial distance at

which the marine mammal was observed from the vessel and closest point of approach; and any avoidance measures taken in response to the marine mammal sighting.

South Fork Wind is required to implement a noise mitigation system to reduce noise during impact pile driving of monopiles such that the measured ranges to Level A harassment and Level B harassment isopleths are equal to or less than those predicted by acoustic modeling, assuming 10-dB attenuation. The proposed IHA included the use of a single BBC, while the final IHA specifies that South Fork Wind must use (at a minimum) a single BBC coupled with an additional noise mitigation device, or a dBBC.

The final IHA requires verification of the Level A harassment and Level B harassment zones through sound field verification (SFV), whereas the proposed IHA only required verification of the Level B harassment zone. Additionally, the final IHA now specifies that NMFS may expand the relevant clearance and shutdown zones in the event that field measurements indicate ranges to Level A harassment and Level B harassment isopleths are consistently greater than the ranges predicted by modeling, assuming 10-dB attenuation (see *Acoustic Monitoring for Sound Field and Harassment Isopleth Verification* section). However, if harassment zones are expanded beyond an additional 1,500 m, additional PSOs must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180°, and of an area with a radius no greater than 1,500 m. Depending on the extent of zone size expansion, reinitiation of consultation under Section 7 of the ESA may be required. Conversely, if initial acoustic field measurements indicate ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10-dB attenuation), South Fork Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles. However, for a modification request to be considered by NMFS, South Fork Wind must have conducted SFV on at least three piles in representative monopile installation locations (*e.g.*,

substrate type, water depth) to verify that zone sizes are consistently smaller than those predicted by modeling, assuming 10-dB attenuation. In the event that subsequently driven monopiles require greater hammer energy or substrate conditions suggest noise generated from the activity could produce larger sound fields, SFV must be conducted for those subsequent piles. Should NMFS approve reductions in zone sizes *(i.e.,* Level A harassment, Level B harassment, clearance and/or shutdown) for impact pile driving of monopiles, the minimum visibility zone will not be decreased to a size smaller than 2.2 km. The shutdown and clearance zones would be equivalent to the measured range to the Level A harassment isopleth plus 10 percent and 20 percent, respectively, rounded up to the nearest 100 m for PSO clarity. The shutdown zone for sei, fin, and sperm whales must not be reduced to a size less than 1,000 m. The visual and PAM clearance and shutdown zones for NARWs must not be decreased, regardless of acoustic field measurements. The Level B harassment zone would be equal to the largest measured range to the Level B harassment isopleth. Finally, the final IHA requires South Fork Wind to report hammer energies required for each monopile installation, as well as ambient noise spectra.

There are several additional planning and reporting requirements included in the final IHA. Specifically, NMFS is requiring that South Fork Wind prepare and submit Pile Driving and Marine Mammal Monitoring Plans to NMFS for review and approval at least 90 days before the start of any pile driving. The plans must include final project design related to all pile driving (*e.g.*, number and type of piles, hammer type, noise mitigation equipment, anticipated start date, etc.), and all information related to PAM PSO protocols and visual PSO protocols (including alternative monitoring technology (*i.e.,* IR/Thermal camera)), for all activities. South Fork Wind must also submit a NARW vessel strike avoidance plan 90 days prior to commencement of vessel use. The plan will describe, at a minimum, how PAM will be conducted to ensure the transit corridor(s) is clear of

NARWs and provide details on vessel-based observer protocols on transiting vessels. Submission of the above plans was not required in the proposed IHA.

When reporting the results of SFV, South Fork Wind must include (in addition to the information that was included as a requirement in the proposed IHA) the bandwidth, hydrophone sensitivity, a description of the depth and sediment type at the recording *and pile-driving* locations, and any action taken to adjust the noise mitigation system. In addition to the final report, the IHA requires South Fork Wind to provide the initial results of SFV to NMFS in an interim report after each monopile installation for the first three piles as soon as they are available, but no later than 48 hours after each installation.

If a NARW is detected via PAM, the date, time, location of the detection, and the recording platform must be reported to NMFS as soon as feasible but no longer than 24 hours after the detection. Full detection data and metadata must be submitted on the 15th of every month for the previous month. Prior to initiation of the project activities, South Fork Wind must demonstrate in a report submitted to NMFS (*itp.esch@noaa.gov*) that all required training has been completed for South Fork Wind personnel (including vessel crew and captains, and PSOs). This report was not required in the proposed IHA. The proposed IHA only required that South Fork Wind submit a draft report on all monitoring conducted under the IHA within 90 days of completion of the monitoring efforts. Since that time, NMFS determined that more frequent reviews of South Fork Wind's monopile installation activities and monitoring data are warranted. In the final IHA, South Fork Wind is required to submit weekly and monthly reports (see Reporting section for details). Finally, NMFS has updated the contact information for reporting injured or dead marine mammals, or a vessel strike, in the event that South Fork Wind needs to report either.

From the proposed IHA to the final IHA, NMFS modified the take number for blue whales. The proposed IHA allocated one take, by Level B harassment, of a blue

whale incidental to impact pile driving of monopiles, even though animal exposure modeling resulted in zero blue whale exposures (by Level A harassment or Level B harassment). However, after further examination, NMFS has determined that the potential for even Level B harassment of this species is *de minimus* and NMFS is not authorizing take by Level B harassment. The area is not a preferred blue whale habitat, as the species generally prefers deeper water and bathymetric features such as the continental shelf edge. In addition, there have been no blue whale sightings during previous monitoring efforts within and near the SFWF and SFEC (*e.g.*, CSA 2020; Smultea Environmental Sciences 2020; Gardline 2021). For these reasons, NFMS does not adopt the Commission's recommendation to authorize (in addition to the proposed single take, by Level B harassment, which is now considered *de minimus*) one take, by Level A harassment (PTS), of a blue whale incidental to impact pile driving of monopiles.

Per the Commission's recommendation, NMFS has modified take, by Level B harassment, incidental to impact pile driving of monopiles for long-finned pilot whales, Atlantic spotted dolphins, common dolphins, and bottlenose dolphins. The take numbers, by Level B harassment, included in the proposed IHA for these species were those requested by South Fork Wind in the IHA application. Upon further review of scientific literature (DoN 2017; Smultea Sciences, 2020; CSA 2921; AMAPPS 2021), NMFS updated the reference for average group size for each species and conservatively selected the largest average group size for each species reported among references as the basis for increasing take numbers from the proposed to the final IHA. NMFS selected the group size reported for long-finned pilot whales (n=20) in CETAP (1982) and increased take, by Level B harassment, from 12 (included in the proposed IHA) to 20 (Table 18). Barkaski and Kelly (2018) report an average group size of 13 for Atlantic spotted dolphins, which is similar to the average group size based on sighting data within and

near the SFWF and SFEC (Smultea Sciences, 2020). To account for group size, NMFS conservatively increased take, by Level B harassment, of Atlantic spotted dolphins from 2 to 13 (Table 18). To account for the frequent occurrence of common dolphins and bottlenose dolphins in the project area, NMFS increased take, by Level B harassment, by multiplying the largest group size (common dolphins (35), bottlenose dolphins (21.6); AMAPPS 2021) by the maximum number of days on which monopile installation might occur (n=16), resulting in 560 common dolphin takes and 346 bottlenose dolphins takes. Given the large size of the Level B harassment zone for vibratory pile driving (approximately 36 km), NMFS agreed with the Commission's recommendation to modify take, by Level B harassment, of humpback whales, as well as common dolphins and Atlantic white-sided dolphins. NMFS based take increases on the largest estimated group sizes for each species using the best available science (DoN 2017; Smultea Sciences, 2020; CSA 2921; AMAPPS 2021). For humpback whales and common dolphins, the largest estimated group sizes (humpback whales (1.6), common dolphins (35); AMAPPS (2021)) were multiplied by the number of days over which vibratory pile driving might occur (18 hours over 3 days for installation, 18 hours over 3 days for removal, total=6 days). This approach resulted in the following increases in takes, by Level B harassment, from the proposed IHA to the final IHA: humpback whales (from 1 to 9.6, rounded to 10) and common dolphins (from 4 to 210). Animal exposure modeling predicted one take, by Level B harassment, of an Atlantic white-sided dolphin incidental to vibratory pile driving, although sightings of this species are uncommon in the project area. However, NMFS has conservatively authorized 50 takes (or the equivalent of the largest seasonal group size, reported for summer; AMAPPS 2021), by Level B harassment, of Atlantic white-sided dolphins. As described in the **Comments and Responses** section, the Commission also recommended increasing take, by Level B harassment, of fin and sei whales incidental to vibratory pile driving. Exposure modeling

resulted in exposures for each of 10 months (October – May; Table 19) for all species potentially impacted by vibratory pile driving. Of the remaining months, fin whale exposure estimates were zero (November-February) and one (in both March and May). The proposed take estimate was already conservatively based on the month with the highest number of modeled exposures (April; n=2), and sightings of fin whales are less frequent along the ECR and nearshore HDD site as compared to in/near the Lease Area (e.g., Smultea Sciences, 2020). For these reasons, NMFS does not find that increasing take of fin whales, by Level B harassment, is warranted. As for sei whales, exposure modeling resulted in zero exposures in all 10 months considered (Table 19). As described in the **Comments and Responses** section, sei whale sightings are relatively rare throughout the project area, which agrees with the generally offshore pattern of sei whale distribution (Hayes et al., 2021). Given the brief timeframe for cofferdam installation/removal, the low likelihood of sei whale occurrence in the project area during that brief timeframe, and the lack of exposures resulting from exposure modeling, NMFS does not find that increasing take, by Level B harassment, is warranted.

After review of the scientific literature, NMFS has increased take of long-finned pilot whales, by Level B harassment, incidental to construction surveys from 4 (proposed) to 20 (authorized) based on the largest estimated group size (CETAP 1982).

Since publication of the proposed IHA, South Fork Wind proposed the installation of a temporary casing pipe using a small pneumatic impact hammer at the horizontal directional drilling (HDD) exit pit location for the SFEC as an alternative to the previously assessed sheet pile cofferdam at the same location. The cofferdam, but not the casing pipe alternative, was considered in the acoustic impact analysis performed by JASCO in support of the South Fork Wind Construction Operation Plan (COP) (Denes *et al.*, 2020a,b). However, JASCO recently provided NMFS with an general assessment of the potential acoustic impacts of casing pipe installation, showing that it is expected to

have less than, or equal, acoustic impact relative to vibratory pile driving to construct a cofferdam. No potential injurious exposures are expected for installation of the cofferdam (see **Estimated Take**), and are, therefore, not expected for installation of the casing pipe. The range to behavioral disruption is less for casing pipe driving using a small impact hammer (approximately 2,154 m) than for cofferdam construction using vibratory pile driving (approximately 36,000 m). If temporary supports for the casing pipe are needed during the HDD installation, vibratory pile driving of up to 8 sheet piles may be required (resulting in a 36,000 m range to behavioral disruption during installation of the support sheet piles). South Fork Wind estimates that the entire installation and removal will each take approximately four hours to complete. In comparison, installation of a temporary cofferdam would require vibratory pile driving of approximately 80-100 sheet piles for up to 18 hours for installation and an additional 18 hours for removal. If vibratory pile driving of support sheet piles for the casing pile is required, the range to the Level B harassment isopleth may be the same as for cofferdam construction, but the potential for take would occur over a shorter duration. Regardless of the construct selected for installation at the exit pit location, South Fork Wind will adhere to the more conservative mitigation and monitoring requirements for the installation of the cofferdam (as proposed by South Fork Wind and described in the notice of the proposed IHA (86 FR 8490; February 5, 2021)). NMFS agrees with this approach, given that the larger zone sizes and longer duration for cofferdam installation/removal encompass the potential spatial and temporal scales for installation of the casing pipe alternative. Accordingly, authorized take (by Level B harassment only) in the final IHA is conservatively based on take incidental to vibratory pile driving associated with installation/removal of the cofferdam.

In addition to the changes described above, NMFS has also 1) revised tables in the **Federal Register** notice and IHA so all the harassment, clearance, and shutdown zones align between the **Federal Register** notice and final IHA, 2) corrected the reported

maximum water depth in the project area to 90 m, 3) corrected a typographical error in Table 8 to reflect the fact that the mean Level A harassment zone for a difficult-to-drive pile based on the cumulative SEL (SEL_{cum}) thresholds for low-frequency cetaceans is 7,868 m rather than 7,846 m, 4) aligned the Level A harassment zones in Tables 10 and 24 based on the SEL_{cum} thresholds for gray seals and in Tables 7 and 24 based on the peak sound pressure level (SPL_{peak}) thresholds for harbor porpoises, and gray and harbor seals, 5) corrected the Level B harassment zone for Chirps to 54 m in Table 28, 6) corrected the Level A harassment zone ($SPL_{0\text{-}pk}$) for high-frequency cetaceans for AA Triple plate S-Boom (700/1,000 J) to 2.8 m in Table 12, 7) removed visibility metrics from the reporting requirements for SFV, and 8) added a target air flow rate of at least 0.5 $m^3/(min*m)$ for the bubble curtain(s) used for noise mitigation during impact pile driving of monopiles. In addition, the final IHA specifies that if a species for which authorization has not been granted, or, a species for which authorization has been granted but the authorized number of takes has been met, approaches or is observed within the *Level B harassment zone* (rather than the clearance zone, as specified in the proposed IHA), impact pile driving of monopiles must not commence or resume until the animal has been confirmed to have left the Level B harassment zone or a full 15 minutes (small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sightings. Finally, NMFS did not include language in the final IHA related to a Renewal IHA. This does not necessarily preclude a Renewal IHA but, as described above, NMFS thinks a Renewal IHA is unlikely in this case, given the potential for changes over the next two years that could affect the analyses germane to construction of the SFWF and SFEC.

Description of Marine Mammals in the Area of Specified Activities

Sections 3 and 4 of the IHA application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life

history of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SARs; *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' website (*www.fisheries.noaa.gov/find-species*).

There are 36 marine mammal species that could potentially occur in the project area and that are included in Table 16 of the IHA application. However, the temporal and/or spatial occurrence of 21 of these species is such that take is not expected to occur or authorized, and they are, therefore, not discussed further beyond the explanation provided here. The following species are not expected to occur in the project area due to their more likely occurrence in habitat that is outside the SFWF and SFEC, based on the best available information: the blue whale (*Balaenoptera musculus*), beluga whale (*Delphinapterus leucas*), northern bottlenose whale (*Hyperoodon ampullatus*), killer whale (*Orcinus orca*), pygmy killer whale (*Feresa attenuata*), false killer whale (*Pseudorca crassidens*), melon-headed whale (*Peponocephala electra*), pygmy sperm whale (*Kogia breviceps*), Cuvier's beaked whale (*Ziphius cavirostris*), Mesplodont beaked whales (spp.), short-finned pilot whale (*Globicephala macrorhynchus*), pantropical spotted dolphin (*Stenella attenuata*), Fraser's dolphin (*Lagenodelphis hosei*), white-beaked dolphin (*Lagenorhynchus albirostris*), rough-toothed dolphin (*Steno bredanensis*), Clymene dolphin (*Stenella clymene*), spinner dolphin (*Stenella longirostris*), and striped dolphin (*Stenella coeruleoalba*). The following species may occur in the project area, but at such low densities that take is not anticipated: hooded seal (*Cystophora cristata*) and harp seal (*Pagophilus groenlandica*). There are two pilot whale species (long-finned (*Globicephala melas*) and short-finned (*Globicephala macrorhynchus*)) with distributions that may overlap in the latitudinal range of the SFWF

(Hayes *et al.*, 2021; Roberts *et al.*, 2016). Because it is difficult to differentiate between the two species at sea, sightings, and thus the densities calculated from them, are generally reported together as *Globicephala* spp. (Hayes *et al.*, 2021; Roberts *et al.*, 2016). However, based on the best available information, short-finned pilot whales generally occur in habitat that is both further offshore on the shelf break and further south than the project area (Hayes *et al.*, 2021). Therefore, NMFS assumes that any take of pilot whales would be of long-finned pilot whales.

In addition, the Florida manatee (*Trichechus manatus*) may be found in the coastal waters of the project area. However, Florida manatees are managed by the U.S. Fish and Wildlife Service and are not considered further in this document.

Between October 2011 and June 2015, a total of 76 aerial surveys were conducted throughout the MA and RI/MA WEAs. As mentioned previously, the SFWF is contained within the RI/MA WEA (along with several other offshore renewable energy Lease Areas). Between November 2011 and March 2015, Marine Autonomous Recording Units (MARUs; a type of static PAM recorder) were deployed at nine sites in the MA and RI/MA WEAs. The goal of the study was to collect visual and acoustic baseline data on distribution, abundance, and temporal occurrence patterns of marine mammals (Kraus *et al.*, 2016). The lack of acoustic detections or sightings of any of the species listed above reinforces the fact that these species are not expected to occur in the project area. In addition, during recent marine site characterization surveys of the South Fork Wind Lease Area, none (other than long-finned pilot whales) of the aforementioned species were observed during marine mammal monitoring (Smultea Sciences, 2020; CSA, 2021). Further, acoustic detections of four species of baleen whales in data collected from 2004-2014 show important distributional changes over the range of these baleen whale species (Davis *et al.*, 2020). That study showed blue whales were more frequently detected in the northern latitudes of the study area after 2010, and no detections occurred in the project

area in spring, summer, and fall when impact pile driving of monopiles would occur (Davis *et al.*, 2020). As the species identified above are not expected to occur in the project area during the planned activities, they are not discussed further in this document.

NMFS expects that the 15 species listed in Table 3 will potentially occur in the project area and may, therefore, be taken as a result of the project. Table 3 summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) and potential biological removal (PBR), where known. For taxonomy, NMFS follows the Committee on Taxonomy (2020). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS' SARs). While no mortality is anticipated or authorized here, PBR is included here as a gross indicator of the status of the species and other threats. Four marine mammal species that are listed under the Endangered Species Act (ESA) may be present in the project area and may be taken incidental to the planned activity: the NARW, fin whale, sei whale, and sperm whale.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Atlantic SARs. All values presented in Table 3 are the most recent available at the time of publication, which can be found in the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021), available online at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*.

Table 3. Marine Mammals Known To Occur In the Project Area That May be Affected By South Fork Wind's Construction Activities

Common Name (Scientific Name)	Stock	MMPA and ESA Status; Strategic (Y/N)[1]	Stock Abundance (CV, N_{min}, most recent abundance survey)[2]	PBR[3]	Annual M/SI[3]	Occurrence and seasonality in project area
Toothed whales (Odontoceti)						
Sperm whale (*Physeter macrocephalus)*	North Atlantic	E; Y	4,349 (0.28; 3,451; 2016)	3.9	0	Rare
Long-finned pilot whale (*Globicephala melas)*	W. North Atlantic	--; N	39,215 (0.3; 30,627; 2016)	306	29	Rare
Atlantic spotted dolphin *(Stenella frontalis*)	W. North Atlantic	--; N	39,921 (0.27; 32,032; 2016)	320	0	Rare
Atlantic white-sided dolphin (*Lagenorhynchus acutus)*	W. North Atlantic	--; N	93,233 (0.71; 54,443; 2016)	544	27	Common year round
Bottlenose dolphin (*Tursiops truncatus)*	W. North Atlantic, Offshore	--; N	62,851 (0.23; 51,914; 2019)	519	28	Common year round
Common dolphin (*Delphinus delphis)*	W. North Atlantic	--; N	172,974 (0.21; 145,216; 2016)	1,452	390	Common year round
Risso's dolphin (*Grampus griseus*)	W. North Atlantic	--; N	35,215 (0.19; 30,051; 2016)	301	34	Rare
Harbor porpoise (*Phocoena phocoena)*	Gulf of Maine/Bay of Fundy	--; N	95,543 (0.31; 74,034; 2019)	851	164	Common year round
Baleen whales (Mysticeti)						
North Atlantic right whale (*Eubalaena glacialis)*	W. North Atlantic	E; Y	368 (0; 364; 2019)	0.7	7.7	Year round in continental shelf and slope waters, occur seasonally
Humpback whale (*Megaptera novaeangliae)*	Gulf of Maine	--; N	1,396 (0.15; 1,375; 2016)	22	58	Common year round

Fin whale (*Balaenoptera physalus)*	W. North Atlantic	E; Y	6,802 (0.24; 5,573; 2016)	11	1.8	Year round in continental shelf and slope waters, occur seasonally
Sei whale (*Balaenoptera borealis)*	Nova Scotia	E; Y	6,292 (1.02; 3,098 ; 2016)	6.2	0.8	Year round in continental shelf and slope waters, occur seasonally
Minke whale (*Balaenoptera acutorostrata)*	Canadian East Coast	--; N	21,968 (0.31; 17,002; 2016)	170	10.6	Year round in continental shelf and slope waters, occur seasonally
Earless seals (Phocidae)						
Gray seal [4] (*Halichoerus grypus)*	W. North Atlantic	--; N	27,300 (0.22; 22,785; 2016)	1,389	4,453	Common year round
Harbor seal (*Phoca vitulina)*	W. North Atlantic	--; N	61,336 (0.08; 57,637; 2012)	1,729	339	Common year round

[1] ESA status: Endangered (E), Threatened (T) / MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] NMFS' 2021 Draft SARs, available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*. CV is coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable.

[3] These values, found in NMFS' SAR, represent annual levels of human-caused mortality plus serious injury from all sources combined *(e.g.*, commercial fisheries, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.

[4] The NMFS stock abundance estimate applies to U.S. population only, however the actual stock abundance is approximately 451,431.

A detailed description of the species for which take has been authorized, including brief introductions to the relevant stocks as well as available information regarding population trends and threats, and information regarding local occurrence, were provided in the **Federal Register** notice for the proposed IHA (86 FR 8490; February 5, 2021). Since that time, the status of some species and stocks have been updated, most notably for large whales. In particular, Pace (2021) and NMFS' 2021 Draft SARS (Hayes *et al*., 2021) provide an updated population estimate of 368 for NARWs, a decrease from the estimate of 412 reported in the notice of the proposed IHA (86 FR

8490; February 5, 2021). Table 3 includes the most recent population abundances, PBR, and annual mortality and serious injury (M/SI) rates for all species. NMFS refers the reader to the proposed IHA **Federal Register** notice for basic descriptions of each species' status, and provides a summary of updates below where necessary. Please also refer to NMFS' website (*https://www.fisheries.noaa.gov/find-species*) for generalized species accounts, and note that Oleson *et al.* (2020) have established the project area as year-round foraging habitat for NARWs.

As described in the proposed IHA notice, beginning in 2017, elevated mortalities in the NARW population have been documented, primarily in Canada but also in the U.S., and were collectively declared an Unusual Mortality Event (UME). As of December 2021, 34 NARWs have been confirmed dead and an additional 16 have been determined to be seriously injured. Entanglement and vessel strikes are the primary causes of M/SI.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To assess the potential effects of exposure to sound appropriately, it is necessary to understand the frequency ranges marine mammals are able to hear. Data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al.*, 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007, 2019) recommended that marine mammals be divided into functional hearing groups based on directly measured, or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2018) described generalized hearing ranges for these marine

mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible; in this case, the lower bound from Southall *et al.* (2007) was retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 4.

Table 4. Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
* Represents the generalized hearing range for the entire group as a composite (*i.e.*, all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.* 2007) and PW pinniped (approximation).	

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.*, 2006; Kastelein *et al.*, 2009; Reichmuth and Holt, 2013).

For more details concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Fifteen marine mammal species (13 cetacean and 2 pinniped (both phocid species); Table 3) have the reasonable potential to co-occur with South Fork Wind's construction activities. Of the cetacean species that may be present, five are classified as low-frequency cetaceans (*i.e.*, all mysticete species),

seven are classified as mid-frequency cetaceans (*i.e.*, all delphinid species and the sperm whale), and one is classified as a high-frequency cetacean (*i.e.*, harbor porpoise).

Potential Effects of Specified Activities on Marine Mammals and their Habitat

The effects of underwater noise from South Fork Wind's construction activities have the potential to result in harassment of marine mammals in the vicinity of the project area. The notice of proposed IHA (86 FR 8490; February 5, 2021) included a discussion of the effects of anthropogenic noise on marine mammals, and the potential effects of underwater noise from South Fork Wind's construction activities on marine mammals and their habitat. That information and analysis is incorporated by reference into this final IHA determination and is not repeated here; for more details, please refer to the notice of proposed IHA (86 FR 8490; February 5, 2021).

Estimated Take

This section provides an estimate of the number of incidental takes authorized through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination. As noted in the summary of **Changes from Proposed IHA to Final IHA**, changes have been made to the number of takes for the given species incidental to: impact pile driving of monopiles (blue whales, pilot whales, Atlantic spotted dolphins, common dolphins, and bottlenose dolphins); vibratory pile driving (humpback whales, common dolphins, white-sided dolphins); and construction surveys (pilot whales). Detailed descriptions are provided in the **Comments and Responses** and **Changes from Proposed IHA to Final IHA** sections, and below.

Harassment is the only type of take expected to result from South Fork Wind's construction activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine

mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized take would primarily be by Level B harassment, as noise from impact and vibratory pile driving and construction surveys has the potential to result in disruption of behavioral patterns for individual marine mammals, either directly or as a result of masking or temporary hearing impairment (also referred to as temporary threshold shift (TTS), as described in the notice of proposed IHA (86 FR 8490, February 5, 2021)). There is also some potential for auditory injury (Level A harassment) to result for select marine mammals. Mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable. No serious injury or mortality is anticipated or authorized for this activity. Below we describe how the take is estimated.

Generally speaking, NMFS estimates take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and (4) and the number of days of activities. NMFS notes that while these basic factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.*, previous monitoring results or average group size). Below, NMFS describes the factors considered here in more detail and presents the authorized take.

Acoustic Thresholds

NMFS recommends the use of acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably

expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.,* 2007, Ellison *et al.*, 2012). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above a received level of 160 dB re 1 μPa (rms) for impulsive and/or intermittent sources. South Fork Wind's activities includes the use of impulsive and intermittent sources (*e.g.*, impact pile driving, HRG acoustic sources), and thus the 160 dB threshold applies. Quantifying Level B harassment in this manner is also expected to capture any qualifying changes in behavioral patterns that may result from TTS.

Level A harassment – NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The components of South Fork Wind's activities that may result in take of marine mammals include the use of impulsive and non-impulsive sources.

These thresholds are provided in Table 5. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance*.

Table 5. Thresholds Identifying the Onset Of Permanent Threshold Shift

Hearing Group	PTS Onset Acoustic Thresholds* (Received Level)	
	Impulsive	Non-impulsive
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	$L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	$L_{E,PW,24h}$: 201 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 µPa, and cumulative sound exposure level (L_E) has a reference value of 1µPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Ensonified Area

Here, NMFS describes operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds, which include source levels and transmission loss coefficient.

Impact Pile Driving of Monopiles: Acoustic range

As described above, South Fork Wind plans install up to 15 WTGs and one OSS in the SFWF (*i.e.,* a maximum of 16 foundations). Two piling scenarios may be

encountered during construction and were, therefore, considered in the modeling conducted to estimate the potential number of marine mammal exposures above relevant harassment thresholds: 1) maximum design, including one difficult-to-drive pile, and 2) standard design with no difficult-to-drive pile included.

The two piling scenarios were modeled separately to conservatively assess the potential impacts of each. The two scenarios modeled were:

1) The "maximum design" consisting of 15 piles requiring ~4,500 strikes per pile (per 24 hours), and one difficult-to-drive pile requiring ~8,000 strikes (per 24 hours)

2) The "standard design" consisting of 16 piles requiring ~4,500 strike per pile (per 24 hours).

Representative hammering schedules of increasing hammer energy with increasing penetration depth were modeled, resulting in generally higher intensity sound fields as the hammer energy and penetration increases (Table 6).

Table 6. Hammer Energy Schedule For Monopile Installation.

Energy level (kilojoule[kJ])	Standard pile strike count (4,500 total)	Difficult pile strike count (8,000 total)	Pile penetration (m)
1,000	500	800	0 - 6
1,500	1,000	1,200	6 – 23.5
2,500	1,500	3,000	23.5 - 41
4,000	1,500	3,000	41 - 45

Monopiles were assumed to be vertical and driven to a penetration depth of 45 m. While pile penetration across the sites would vary, this value was chosen as a reasonable maximum penetration depth. All acoustic modeling was performed assuming that only one pile is driven at a time.

Additional modeling assumptions for the monopiles were as follows:

- One pile installed per day.
- 10.97-m steel cylindrical piling with wall thickness of 10 cm.
- Impact pile driver: IHC S-4000 (4000 kilojoules (kJ) rated energy; 1977 kilonewtons (kN) ram weight).
- Helmet weight: 3234 kN.

As described in the **Comments and Responses** section, sound fields produced during monopile installation were estimated by first computing the force at the top of each pile associated with typical hammers using the GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010), which produced forcing functions. The source signatures of each monopile were predicted using the TDFD PDSM to compute the monopile vibrations caused by hammer impact. To accurately calculate propagation metrics of an impulsive sound, a time-domain representation of the pressure wave in the water was used. To model the sound waves associated with the monopile vibration in an acoustic propagation model, the monopiles are represented as vertical arrays of discrete point sources. The discrete sources are distributed throughout the length of the monopile below the sea surface and into the sediment with vertical separation of 3 m. The length of the acoustic source is adjusted for the site-specific water depth and penetration at each energy level, and the section length of the monopile within the sediment is based on the monopile hammering schedule (Table 6). Pressure signatures for the point sources are computed from the particle velocity at the monopile wall up to a maximum frequency of 2,048 Hz. This frequency range is suitable because most of the sound energy generated by impact hammering of the monopiles is below 1 kHz.

As described previously, to calculate predicted propagation of sounds produced during impact pile driving of monopiles below 2 kHz, JASCO used it's FWRAM, which is an acoustic model based on the wide-angle parabolic equation (PE) algorithm (Collins 1993). FWRAM computes synthetic pressure waveforms versus range and depth for

range-varying marine acoustic environments. It takes environmental inputs (*e.g.*, bathymetry, sound velocity profile, and seabed geoacoustic profile) and computes pressure waveforms at grid points of range and depth. Because the monopile is represented as a linear array and FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012), using FWRAM ensures accurate characterization of vertical directivity effects in the near-field zone. JASCO used BELLHOP, a Gaussian beam ray-trace model that also incorporates environmental inputs, to model propagation of sound produced above 2 kHz during monopile installation. The beam-tracing model is described as an approximation of a given source by a fan of beams through the medium. Then, the quantities of interest (*e.g.*, acoustic pressure at different ranges) are computed at a specified location by summing the contribution of each of the individual beams.

Two locations within the SFWF were selected to provide representative propagation and sound fields for the project area (see Figure 1 in SFWF COP, Appendix J1). The two locations were selected to span the region from shallow to deeper water and varying distances to dominant bathymetric features (*i.e.*, slope and shelf break). Water depth and environmental characteristics (*e.g.*, bottom-type) are similar throughout the SFWF, and therefore minimal differences were found in sound propagation results for the two sites (Denes *et al.*, 2018). Propagation modeling also incorporated two different sound velocity profiles (based on *in situ* measurements of temperature, salinity, and pressure within the water column) to account for variations in the acoustic propagation conditions between summer and winter. Estimated impact pile driving of monopiles schedules (Table 6) were used to calculate the SEL sound fields at different points in time during monopile installation.

The sound propagation modeling incorporated site-specific environmental data that describes the bathymetry, sound speed in the water column, and seabed geoacoustics in the construction area. Sound level estimates were calculated from three-dimensional sound fields and then at each horizontal sampling range, the maximum received level that occurs within the water column is used as the received level at that range. These maximum-over-depth (R_{max}) values are then compared to predetermined threshold levels to determine acoustic ranges to Level A harassment and Level B harassment isopleths. However, the ranges to an isopleth typically differ among radii from a source, and might not be continuous because sound levels may drop below threshold at some ranges and then exceed threshold at farther ranges. To minimize the influence of these inconsistencies, 5 percent of such footprints were excluded from the model data. The resulting range, $R_{95percent}$, is used because, regardless of the shape of the maximum-over-depth footprint, the predicted range encompasses at least 95 percent of the horizontal area that would be exposed to sound at or above the specified threshold. The difference between R_{max} and $R_{95percent}$ depends on the source directivity and the heterogeneity of the acoustic environment. $R_{95percent}$ excludes ends of protruding areas or small isolated acoustic foci not representative of the nominal ensonified zone (see Figure 12; SFWF COP Appendix J1).

The modeled source spectrum is provided in Figure 7 of the SFWF COP (Appendix J1). The dominant energy for both impact pile-driving scenarios ("maximum" and "standard") is below 1000 Hz. Please see Appendix J1 of the SFWF COP for further details on the modeling methodology (Denes *et al.*, 2020a).

South Fork Wind will employ a noise mitigation system during all impact pile driving of monopiles. Bubble curtains, one type of noise mitigation technology, are sometimes used to decrease the sound levels radiated from a source. Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the

bubbles determines their effective frequency band, with larger bubbles needed to attenuate lower frequencies. There are a variety of bubble curtain systems, confined or unconfined, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. Small bubble curtains have been shown to reduce sound levels, but effective attenuation is highly dependent on depth of water, current, and configuration and operation of the curtain (Austin, Denes, MacDonnell, & Warner, 2016; Koschinski & Lüdemann, 2013). Bubble curtains vary in terms of the sizes of the bubbles Those with larger bubbles tend to perform a bit better and more reliably, particularly when deployed with two separate rings (*i.e.*, dBBC) (Bellmann, 2014; Koschinski & Lüdemann, 2013; Nehls, Rose, Diederichs, Bellmann, & Pehlke, 2016).

Encapsulated bubble systems (*e.g.*, Hydro Sound Dampers (HSDs)), can be effective within their targeted frequency ranges, *e.g.*, 100-800 Hz, and when used in conjunction with a bubble curtain appear to create the greatest attenuation. The literature presents a wide array of observed attenuation results for bubble curtains. The variability in attenuation levels is the result of variation in design, as well as differences in site conditions and difficulty of properly installing and operating in-water attenuation devices. A California Department of Transportation (CalTrans) study tested several systems and found that the best attenuation systems resulted in 10-15 dB of attenuation (Buehler *et al.,* 2015). Similarly, Dähne *et al.* (2017) found that single BBCs that reduced sound levels by 7-10 dB reduced the overall sound level by ~12 dB when combined with a dBBC for 6-m steel monopiles in the North Sea. Bellmann *et al.* (2020) provide a review of the efficacy of using bubble curtains (both single and double) as noise abatement systems in the German EEZ of the North and Baltic Seas. For 8-m diameter monopiles, single BBCs achieved an average of 11-dB broadband noise reduction (Bellmann *et al.*, 2020). In modeling the sound fields for South Fork Wind's activities, hypothetical broadband attenuation levels of 0-, 6-, 10-, 12-, and 15-dB were modeled to

gauge the effects on the ranges to isopleths given these levels of attenuation. Although five attenuation levels (and associated ranges) are provided, South Fork Wind anticipates that the use of a noise mitigation system will produce field measurements of the ranges to the Level A harassment and Level B harassment isopleths that accord with those modeled assuming 10-dB attenuation. To account for variability, ensure harassment zone sizes are no larger than those assumed in this analysis, and ensure that sound levels are reduced to the lowest level practicable, South Fork Wind is required to employ an additional noise mitigation device if using a single BBC. Alternatively, a dBBC may be used without use of additional noise mitigation equipment.

The acoustic thresholds for impulsive sounds (such as impact pile driving) contained in the Technical Guidance (NMFS, 2018) were presented as dual metric acoustic thresholds using both SEL_{cum} and SPL_{peak} (Table 5). As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (*i.e.*, metric resulting in the largest isopleth). The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group.

Tables 7 and 8 shows the modeled acoustic ranges to the Level A harassment isopleths, with 0, 6 10, 12, and 15-dB sound attenuation incorporated. For the peak level, the greatest ranges expected within a given hearing group are shown, typically occurring at the highest hammer energy (Table 7). The SEL_{cum} Level A harassment threshold is the only metric that is affected by the number of strikes within a 24-hour period; therefore, it is only this acoustic threshold that is associated with differences in range estimates between the standard scenario and the difficult-to drive pile scenario (Table 8). The maximum ranges for SPL_{peak} are equal for both scenarios because this metric is used to define characteristics of a single impulse and does vary based on the number of strikes (Denes *et al.*, 2020a). The radial ranges shown in Tables 7 and 8 are the mean ranges

from the piles, averaged between the two modeled locations and between summer and winter sound velocity profiles.

Table 7. Mean Acoustic Range ($R_{95\%}$) to Level A Peak Sound Pressure Level (SPL_{peak}) Harassment Isopleths For Marine Mammals Due to Impact Pile Driving Of Monopiles

Marine Mammal Hearing Group	Threshold SPL_{peak} (dB re 1 µPa)	Mean range (m) to isopleth				
		0 dB attenuation	6 dB attenuation	10 dB attenuation	12 dB attenuation	15 dB attenuation
Low-frequency cetaceans	219	87	22	9	7	2
Mid-frequency cetaceans	230	8	2	1	1	1
High-frequency cetaceans	202	1,545	541	243	183	108
Phocid pinnipeds	218	101	26	12	8	2

dB re 1 µPa=decibel referenced to 1 micropascal.

Table 8. Mean Acoustic Range ($R_{95\%}$) to Level A Sound Exposure Level (SEL_{cum}) Harassment Isopleths For Marine Mammals Due to Impact Pile Driving Of a Standard Monopile (S; 4,500 strikes*) and a Difficult-to-Drive-Monopile (D; 8,000 strikes*)

Marine Mammal Hearing Group	Threshold SEL_{cum} (dB re 1 μPa^2 s)	Mean range (m) to isopleth									
		0 dB attenuation		6 dB attenuation		10 dB attenuation		12 dB attenuation		15 dB attenuation	
		S	D	S	D	S	D	S	D	S	D
Low-frequency cetaceans	183	16,416	21,941	8,888	11,702	6,085	7,846	5,015	6,520	3,676	4,870
Mid-frequency cetaceans	185	107	183	43	59	27	32	27	26	26	26
High-frequency cetaceans	155	9,290	13,374	4,012	6,064	2,174	3,314	2,006	2,315	814	1,388
Phocid pinnipeds	185	3,224	4,523	1,375	2,084	673	1,080	437	769	230	415

dB re 1 μPa^2s=decibel referenced to 1 micropascal squared second;

*Approximation

Table 9 shows the acoustic ranges to the Level B harassment isopleth with no attenuation, 6-, 10-, 12-, and 15-dB sound attenuation incorporated. Acoustic propagation

was modeled at two representative sites in the SFWF, as described above. The radial ranges shown in Table 8 are the mean ranges to the Level B harassment isopleth, derived by averaging the $R_{95percent}$ to the Level B harassment threshold for summer and winter (see Appendix P2 of the SFWF COP for more details). The range estimated assuming 10-dB attenuation (4,684 m) was used to identify the extent of the Level B harassment zone for impact pile driving of monopiles.

Table 9. Mean Acoustic Ranges ($R_{95percent}$) to Level B Harassment Isopleth (SPL_{rms}) Due to Impact Pile Driving of Monopiles

Threshold SPL_{rms} (dB re 1 µPa)	Mean range (m) to isopleth				
	0 dB attenuation	6 dB attenuation	10 dB attenuation	12 dB attenuation	15 dB attenuation
160	11,382	6,884	4,684	4,164	3,272

dB re 1 µPa=decibel referenced to 1 micropascal.

Impact Pile Driving of Monopiles: Exposure-based Ranges

Modeled acoustic ranges to harassment isopleths may overestimate the actual ranges at which animals receive exposures meeting the Level A (SEL_{cum}) harassment threshold criterion. Therefore, such ranges are not realistic, particularly for accumulating metrics like SEL_{cum}. Applying animal movement and behavior (Denes *et al.*, 2020c) within the propagated noise fields provides the exposure range, which results in a more realistic indication of the ranges at which acoustic thresholds are met. For modeled animals that have received enough acoustic energy to exceed a given threshold, the exposure range for each animal is defined as the closest point of approach (CPA) to the source made by that animal while it moved throughout the modeled sound field, accumulating received acoustic energy. The resulting exposure range for each species is the 95^{th} percentile of the CPA ranges for all animals that exceeded threshold levels for that species (termed the 95 percent exposure range ($ER_{95percent}$)). Notably, the $ER_{95percent}$ are species-specific rather than categorized only by hearing group, which affords more

biologically-relevant data (*e.g.*, dive durations, swim speeds, etc.) to be considered when assessing impact ranges. The $ER_{95percent}$ values for SEL_{cum} provided in Table 10 are smaller than the acoustic ranges calculated using propagation modeling alone (Table 7 and 8). Please see the **Estimated Take** section below and Appendix P1 of the SFWF COP for further detail on the acoustic modeling methodology. The $ER_{95percent}$ ranges assuming 10-dB attenuation for a difficult-to-drive pile were used to determine the Level A harassment zones for impact pile driving of monopiles

Table 10. Exposure-Based Ranges ($ER_{95percent}$) to Level A Harassment Sound Exposure Level (SEL_{cum}) Harassment Isopleths Due to Impact Pile Driving Of a Standard Monopile (S; 4,500 strikes*) and a Difficult-to-Drive-Monopile (D; 8,000 strikes*)

Species	$ER_{95\%}$ to SEL_{cum} isopleths (m)									
	0 dB attenuation		6 dB attenuation		10 dB attenuation		12 dB attenuation		15 dB attenuation	
	S	D	S	D	S	D	S	D	S	D
Low-Frequency Cetaceans										
Fin whale	5,386	6,741	2,655	2,982	1,451	1,769	959	1,381	552	621
Minke whale	5,196	6,033	2,845	2,882	1,488	1,571	887	964	524	628
Sei whale	5,287	6,488	2,648	3,144	1,346	1,756	1,023	1,518	396	591
Humpback whale	9,333	11,287	5,195	5,947	3,034	3,642	2,450	2,693	1,593	1,813
North Atlantic right whale	4,931	5,857	2,514	3,295	1,481	1,621	918	1,070	427	725
Mid-Frequency Cetaceans										
Sperm whale	0	0	0	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0
Atlantic white-sided	20	6	20	6	0	0	0	0	0	0

dolphin										
Common dolphin	0	0	0	0	0	0	0	0	0	0
Risso's dolphin	24	13	24	0	0	0	0	0	0	0
Bottlenose dolphin	13	13	0	0	0	0	0	0	0	0
Long-finned pilot whale	0	0	0	0	0	0	0	0	0	0
High-frequency Cetaceans										
Harbor porpoise	2,845	3,934	683	996	79	365	26	39	21	26
Pinnipeds in water										
Gray seal	1,559	1,986	276	552	46	117	0	21	0	21
Harbor seal	1,421	2,284	362	513	22	85	22	0	21	0

dB re 1 $\mu Pa^2 s$=decibel referenced to 1 micropascal squared second.
*Approximation

Cofferdam Installation and Removal

Similar to cylindrical piles, sheet piles are a distributed acoustic source that can be treated as a linear array of point sources. The acoustic source modeling of vibratory driving of sheet piles was conducted following the same steps used to model impact pile driving. An American Pile-driving Equipment APE Model 200T with Model 200 Universal Clamp was modeled driving a19.5-meter-long (64-foot-long), 0.95 cm (3/8 in) thick, Z-type sheet pile 9 m (30 feet) into the sediment in 9 m (30 ft) of water. The forcing function was modeled for a single cycle of the vibrating hammer using GRLWEAP 2010 wave equation model (GRLWEAP, Pile Dynamics 2010). The finite difference (FD) model was used to compute the resulting pile vibrations from the stress wave that propagates down the sheet pile. The radiated sound waves were modeled as discrete point sources over the 18 m (60 ft) of the pile in the water and sediment (9 m [30 ft] water depth, 9 m [30 ft] penetration) with a vertical separation of 10 cm. The source level spectrum for vibratory pile driving of a sheet pile for a cofferdam at the export cable landfall site is shown in Figure 9 in Denes *et al*. (2020a).

Underwater sound propagation (*i.e.*, transmission loss) as a function of range from each point source was modeled at one construction site using JASCO's Marine Operations Noise Model (MONM). MONM computes received sound energy, the sound exposure level (SEL), for directional sources. MONM uses a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM's predictions have been validated against experimental data from several underwater acoustic measurement programs conducted by JASCO (Hannay and Racca 2005, Aerts et al. 2008, Funk et al.

2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b). MONM accounts for the additional reflection loss at the seabed due to partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates site-specific environmental properties, such as bathymetry, underwater sound speed as a function of depth, and a geoacoustic profile the seafloor. MONM treats frequency dependence by computing acoustic transmission loss at the center frequencies of 1/3-octave-bands. At each center frequency, the transmission loss is modeled as a function of depth and range from the source. Composite broadband received SELs are then computed by summing the received 1/3-octave-band levels across the modeled frequency range.

For computational efficiency, MONM and similar models such as PE-RAM, do not track temporal aspects of the propagating signal (as opposed to the models used for impact pile driving that can output time-domain pressure signals). It is the total sound energy transmission loss that is calculated. For our purposes, that is equivalent to propagating the SEL acoustic metric. For continuous, steady-state signals SPL is readily obtained from the SEL.

Removal of the cofferdam using a vibratory extractor is expected to be acoustically comparable to installation activities. No noise mitigation system will be used during vibratory piling. Summaries of the maximum ranges to Level A harassment isopleths and the Level B harassment isopleth resulting from propagation modeling of vibratory pile driving are provided in Table 11. Peak thresholds were not reached for any marine mammal hearing group.

The large range to the Level B harassment isopleth resulting from vibratory piling installation and removal is, in part, a reflection of the threshold set for behavioral disturbance from a continuous noise (*i.e.,* 120 dB rms). In addition (as discussed in the

Comments and Responses section), the source level (SPL of 180 dB re 1 µPa at 31 m) for installation of sheet piles for the cofferdam is likely an overestimate but was considered acceptable for the following reasons: 1) the source level (SPL 160-165 dB re 1 µPa measured at 10 m) for vibratory pile driving of sheet piles cited in Caltrans (2016, 2020) and provided in NOAA's Pile Driving Noise Calculator spreadsheet (Caltrans 2012, 2015) (available at *https://media.fisheries.noaa.gov/2021-02/SERO%20Pile%20Driving%20Noise%20Calculator_for%20web.xlsx?null*) is based on measurements of a small number of piles for which vibratory pile driving was only used to set the pile prior to impact pile driving to the final desired penetration depth, whereas South Fork Wind would be vibratory pile driving sheet piles to the full extent of the desired penetration depth, and 2) the pile (and vibratory hammer) will potentially encounter more resistance with depth and, therefore, require more hammer energy, during installation of the cofferdam because the piles will be driven to a deeper depth than those included in Caltrans (2016, 2020). Finally, Level B harassment is highly contextual for different species and the range to the isopleth does not represent a definitive impact zone or a suggested mitigation zone; rather, the information serves as the basis for assessing potential impacts within the context of the project and potentially exposed species.

Table 11. Ranges to Level A Cumulative Sound Exposure Level (SEL_{cum}) Harassment Isopleth and Level B Root-Mean-Square Sound Pressure Level (SPL_{rms}) Harassment Isopleth Due to 18 Hours Of Vibratory Pile Driving[1]

Marine Mammal Hearing Group	Level A Harassment Threshold SEL_{cum} (dB re 1 μPa^2 s)	Maximum Range (m) to Level A Harassment Isopleth	Level B Harassment Threshold SPL_{rms} (dB re 1 µPa)	Maximum Range (m) to Level B Harassment Isopleth
Low-frequency cetaceans	199	1,470	120	36,766
Mid-frequency cetaceans	198	0	120	36,766
High-frequency cetaceans	173	63	120	36,766
Phocid pinnipeds	201	103	120	36,766

[1]Although South Fork Wind may conduct a combination of impact and vibratory pile driving to install a casing pipe alternative to the cofferdam, mitigation and monitoring will be implemented based on ranges presented here.

dB re 1 µPa=decibel referenced to 1 micropascal; μPa^2 s=decibel referenced to 1 micropascal squared second.

Construction Surveys

Ranges to Level A harassment isopleths for HRG equipment planned for use and all marine mammal functional hearing groups were modeled using the NMFS User Spreadsheet and NMFS Technical Guidance (2018), which provides a conservative approach to exposure estimation. However, sources that project a narrower beam, often in frequencies above 10 kHz directed at the seabed, are expected to have smaller distances to isopleths and less horizontal propagation due to the directionality of the source and faster attenuation rate of higher frequencies. Narrow beamwidths allow these HRG sources to be highly directional, focusing energy in the vertical direction and minimizing horizontal propagation, which greatly reduces the possibility of direct path exposure to receivers (*i.e.*, marine mammals) from sounds emitted by these sources.

NMFS has developed a user-friendly methodology for determining the sound pressure level (SPL_{rms}) at the 160-dB isopleth for the purposes of estimating the extent of Level B harassment isopleths associated with HRG survey equipment (NMFS, 2020). This methodology incorporates frequency-dependent absorption and some directionality to refine estimated ensonified zones. South Fork Wind used NMFS' methodology with additional modifications to incorporate a seawater absorption formula and account for energy emitted outside of the primary beam of the source. Therefore, for sources with beamwidths less than 180°, ranges to the Level B harassment isopleth were calculated following NMFS's methodology (NMFS, 2020) to account for the influence of beamwidth and frequency on the horizontal propagation of these sources. For sources that operate with different beam widths, the maximum beam width was used (see Table 2). The lowest frequency of the source was used when calculating the absorption coefficient (Table 2).

NMFS considers the data provided by Crocker and Fratantonio (2016) to represent the best available information on source levels associated with HRG equipment and, therefore, recommends that source levels provided by Crocker and Fratantonio (2016) be incorporated in the method described above to estimate ranges to the Level A harassment and Level B harassment isopleths. In cases when the source level for a specific type of HRG equipment is not provided in Crocker and Fratantonio (2016), NMFS recommends that either the source levels provided by the manufacturer be used, or, in instances where source levels provided by the manufacturer are unavailable or unreliable, a proxy from Crocker and Fratantonio (2016) be used instead. Table 2 shows the HRG equipment types that may be used during the construction surveys and the sound levels associated with those HRG equipment types.

Results of modeling using the methodology described above indicated that, of the HRG equipment planned for use by South Fork Wind that has the potential to result in Level B harassment of marine mammals, sound produced by the Applied Acoustics Dura-Spark UHD sparkers and GeoMarine Geo-Source sparker would propagate furthest to the Level B harassment isopleth (141 m; Table 12). For the purposes of the exposure analysis, it was conservatively assumed that sparkers would be the dominant acoustic source for all survey days. Thus, the range to the isopleth corresponding to the threshold for Level B harassment for sparkers (141 m) was used as the basis of the take calculation for all marine mammals.

Table 12. Range to Weighted Level A Harassment and Unweighted Level B Harassment Isopleths For Each HRG Sound Source or Comparable Sound Source Category For Marine Mammal Hearing Groups

Source	Range to Level A Harassment Isopleth (m)					Range to Level B Harassment Isopleth (m)
	LF (SEL_{cum} threshold)	MF (SEL_{cum} threshold)	HF (SEL_{cum} threshold)	HF ($SPL_{0\text{-}pk}$ threshold)	PW (SEL_{cum} threshold)	All species
Shallow SBPs						
ET 216 CHIRP	< 1	< 1	2.9	-	0	12
ET 424 CHIRP	0	0	0	-	0	4
ET 512i CHIRP	0	0	< 1	-	0	6

GeoPulse 5430	< 1	< 1	36.5	-	< 1	29
TB CHIRP III	1.5	< 1	16.9	-	< 1	54
Medium SBPs						
AA Triple plate S-Boom (700/1,000 J)	< 1	0	0	4.7	< 1	76
AA, Dura-spark UHD (500 J/400 tip)	< 1	0	0	2.8	< 1	141
AA, Dura-spark UHD 400+400	< 1	0	0	2.8	< 1	141
GeoMarine, Geo-Source dual 400 tip sparker	< 1	0	0	2.8	< 1	141

- =not applicable; µPa=micropascal; AA=Applied Acoustics; Chirp=Compressed High-Intensity Radiated Pulse; dB=decibels; ET=EdgeTech; HF =high-frequency; J=joules; LF=low-frequency; MF=mid-frequency; PW=Phocids in water; re=referenced to; SBP=sub-bottom profiler; SEL_{cum}=cumulative sound exposure level in dB re 1 μPa^2 s; $SPL_{0\text{-}pk}$=zero to peak sound pressure level in dB re 1 µPa; TB=teledyne benthos; UHD=ultra-high definition; USBL=ultra-short baseline.

Marine Mammal Occurrence

This section provides information about the presence, density, or group dynamics of marine mammals that will inform the take calculations. The best available information regarding marine mammal densities in the project area is provided by habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory (Roberts *et al.*, 2016, 2017, 2018, 2020). Density models were originally developed for all cetacean taxa in the U.S. Atlantic (Roberts *et al.*, 2016); more information, including the model results and supplementary information for each of those models, is available at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/*. In subsequent years, certain models have been updated on the basis of additional data as well as certain methodological improvements. Although these updated models (and a newly developed seal density model) are not currently publicly available, our evaluation of the updates leads to the conclusion that these modeled densities represent the best scientific evidence available. Marine mammal density estimates in the SFWF (animals/km^2) were obtained using these model results (Roberts *et al.*, 2016, 2017, 2018, 2020). As noted in the **Comments and Responses** section, the updated models incorporate additional sighting data, including sightings from the NOAA Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys from 2010-2016, which included some aerial surveys over the RI/MA WEAs (NEFSC & SEFSC, 2011a, 2011b, 2012, 2014a, 2014b, 2015, 2016). In addition, the 2020 update to the NARW density model (Roberts *et al.*, 2020) includes, for

the first time, data from the 2011-2015 surveys of the MA and RI/MA WEAs (Kraus *et al.* 2016) as well as the 2017-2018 continuation of those surveys, known as the Marine Mammal Surveys of the Wind Energy Areas (MMS-WEA) (Quintana *et al.*, 2018).

Densities of marine mammals and their subsequent exposure risk are different for the SFWF area (where impact pile driving of monopiles will occur), the nearshore export cable landing area (where vibratory pile driving will occur), and the construction survey area. Therefore, density blocks (Roberts *et al.*, 2016; Roberts *et al*., 2018) specific to each activity area were selected for evaluating the potential numbers of take for the 15 assessed species. The Denes *et al.* (2020b) model analysis utilized NARW densities from the most recent survey period, 2010-2018, as suggested by Roberts *et al.* (2020).

Monopile Installation

Mean monthly densities for all animals were calculated using a 60 km (37.3 mi) square centered on SFWF and overlaying it on the density maps from Roberts *et al.* (2016, 2017, 2018, 2020). The relatively large area selected for density estimation encompasses and extends beyond the estimated ranges to the isopleth corresponding to Level B harassment (with no attenuation, as well as with 6, 10, 12 and 15-dB sound attenuation) for all hearing groups using the unweighted threshold of 160 dB re 1 µPa (rms) (Table 9). Please see Figure 3 in the SFWF COP (Appendix P2) for an example of a density map showing Roberts *et al.* (2016, 2017, 2018, 2020) density grid cells overlaid on a map of the SFWF.

The mean density for each month was determined by calculating the unweighted mean of all 10 x 10 km (6.2 x 6.2 mi) grid cells partially or fully within the buffer zone polygon. Mean values from the density maps were converted from units of abundance (animals/100 km^2 [38.6 $miles^2$]) to units of density (animals/km^2). Densities were computed for the months of May to December to coincide with planned impact pile driving of monopile activities (as described above, no impact pile driving of monopiles

may occur from December (with caveats) through April). In cases where monthly densities were unavailable, annual mean densities (*e.g.*, pilot whales) and seasonal mean densities (*e.g.*, all seals) were used instead. Table 13 shows the monthly marine mammal density estimates for each species incorporated in the exposure modeling analysis. To obtain conservative exposure estimates, South Fork Wind used the maximum of the mean monthly (May to December) densities for each species to estimate the number of individuals of each species exposed to sound above Level A harassment and Level B harassment thresholds. The maximum densities applied are denoted by an asterisk.

Table 13. Estimated Densities (animals/km^{-2}) Used For Modeling Marine Mammal Exposures Incidental to Monopile Installation Within South Fork Wind Farm

Common Name	Monthly Density (Animals km^{-2})							
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fin whale	0.00201	0.00219	0.00264*	0.00251	0.00217	0.00145	0.00102	0.00105
Minke whale	0.00163*	0.00143	0.00047	0.00026	0.00027	0.00049	0.00022	0.00032
Sei whale	0.00019*	0.00013	0.00003	0.00002	0.00003	0.00000	0.00001	0.00001
Humpback whale	0.00133	0.00148	0.00069	0.00094	0.00317*	0.00156	0.00042	0.00061
North Atlantic right whale	0.00154*	0.00011	0.00002	0.00001	0.00001	0.00005	0.00029	0.00151
Blue whale	0.00001*							
Sperm whale	0.00002	0.00008	0.00031*	0.00024	0.00010	0.00007	0.00007	0.00001
Atlantic white-sided dolphin	0.03900*	0.03600	0.02500	0.01300	0.01500	0.02200	0.02100	0.02800
Atlantic spotted dolphin	0.00012	0.00016	0.00034	0.00041	0.00051	0.00058*	0.00037	0.00007
Bottlenose dolphin	0.00496	0.01800	0.03700	0.03800	0.04000*	0.02000	0.00962	0.00846
Pilot whales[1]	0.00596*							
Risso's dolphin	0.00005	0.00005	0.00018	0.00026*	0.00015	0.00005	0.00009	0.00019
Common dolphin	0.04400	0.04600	0.04300	0.06200	0.10200	0.12800	0.09800	0.20400*
Harbor porpoise	0.03800*	0.00236	0.00160	0.00172	0.00161	0.00399	0.02400	0.02300
Gray seal	0.03900*	0.02600	0.00874	0.00357	0.00529	0.00955	0.00630	0.03400
Harbor seal	0.03900*	0.02600	0.00874	0.00357	0.00529	0.00955	0.00630	0.03400

*Denotes the highest monthly density estimated.
[1.]Long- and short-finned pilot whales are grouped together to estimate the total density of both species.

Cofferdam Installation and Removal

Marine mammal densities in the nearshore export cable landing area were estimated from the 10 × 10 km habitat density blocks that contained the anticipated potential

locations (separated by 22 km) of the cofferdam. Monthly marine mammal densities for the potential construction locations of the cofferdam are provided in Table 14. The maximum densities (denoted by an asterisk) were incorporated in the exposure modeling to obtain the most conservative estimates of potential take by Level A harassment or Level B harassment.

The species listed in each respective density table represent animals that could be reasonably expected to occur within the Level B harassment zone, in the months during which the cofferdam could potentially be installed and extracted (*e.g.,* installation likely between November and April; removal could occur anytime up to expiration of the IHA). Several of the outer continental shelf and deeper water species that appear in the SFWF area are not included in the cofferdam species list because the densities were zero for those species.

Table 14. Estimated Densities (animals/km^{-2}) Used For Modeling Marine Mammal Exposures Within the Affected Area and Construction Schedule Of the Cofferdam Installation

Species[1]	Jan	Feb	Mar	Apr	May	Oct	Nov	Dec
Fin whale	0.0001	0.0001	0.0002	0.0005*	0.0002	0.0002	0.0001	0.0001
Minke whale	0.0005	0.0008*	0.0008	0.0000	0.0000	0.0000	0.0005	0.0005
Sei whale	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
Humpback whale	0.0002*	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0002
North Atlantic right whale	0.0014*	0.0014	0.0013	0.0008	0.0003	0.0000	0.0002	0.0008
Atlantic white-sided dolphin	0.0001	0.0000	0.0001	0.0002	0.0003*	0.0003	0.0003	0.0002
Common dolphin	0.0003	0.0001	0.0001	0.0003	0.0007	0.0007	0.0010*	0.0008
Bottlenose dolphin	0.0694	0.0296	0.0157	0.0474	0.3625	0.4822*	0.2614	0.0809
Harbor porpoise	0.0007	0.0005	0.0005	0.0011	0.0007	0.0026*	0.0003	0.0006
Gray seal	0.3136*	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136
Harbor seal	0.3136*	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136

* Denotes density used for take estimates.

[1] Only species with potential exposures are listed.

Construction Surveys

Densities for construction surveys were combined for the SFWF area (inter-array cables) and the SFEC using density blocks that encompassed those areas. The densities used for construction surveys are provided in Table 15. Average annual, rather than maximum monthly, densities were estimated to account for spatial variability in the

distribution of marine mammals throughout the SFWF and SFEC and temporal variability in distribution over the 12-month timeframe during which construction surveys would occur.

Table 15. Estimated Densities (animals/km^2) Of Marine Mammals Within the Construction Survey Area (Export Cable Routes and Inter-Array Cables)

Species	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Annual Average*
Fin whale	0.0020	0.0015	0.0016	0.0027	0.0022	0.0022	0.0025	0.0024	0.0018	0.0018	0.0016	0.0022	0.0020
Minke whale	0.0006	0.0007	0.0006	0.0004	0.0005	0.0006	0.0006	0.0004	0.0002	0.0001	0.0006	0.0006	0.0005
Sei whale	0.0001	0.0001	0.0001	0.0002	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
Humpback whale	0.0008	0.0007	0.0008	0.0006	0.0009	0.0013	0.0008	0.0010	0.0013	0.0013	0.0013	0.0007	0.0010
North Atlantic right whale	0.0038	0.0053	0.0060	0.0054	0.0016	0.0001	0.0000	0.0000	0.0000	0.0000	0.0003	0.0017	0.0020
Sperm whale	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Atlantic white-sided dolphin	0.0227	0.0103	0.0078	0.0172	0.0326	0.0276	0.0178	0.0126	0.0202	0.0267	0.0298	0.0352	0.0217
Atlantic spotted dolphin	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Common dolphin	0.0218	0.0100	0.0085	0.0182	0.0568	0.0645	0.0417	0.0456	0.0468	0.0538	0.0600	0.0506	0.0399
Bottlenose dolphin	0.0081	0.0033	0.0014	0.0035	0.0241	0.0324	0.0544	0.0405	0.0393	0.0392	0.0271	0.0108	0.0237
Risso's dolphin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Long-finned pilot whale	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Harbor porpoise	0.0871	0.0584	0.0475	0.0964	0.0547	0.0182	0.0037	0.0014	0.0024	0.0150	0.0046	0.0482	0.0365
Gray seal	0.0151	0.0151	0.0151	0.0151	0.0151	0.0030	0.0030	0.0030	0.0151	0.0151	0.0151	0.0151	0.0121
Harbor seal	0.0151	0.0151	0.0151	0.0151	0.0151	0.0030	0.0030	0.0030	0.0151	0.0151	0.0151	0.0151	0.0121

*Average annual density used for take estimates.

Take Calculation and Estimation

Below is a description of how the information provided above is brought together to produce a quantitative take estimate. The following steps were performed to estimate the potential numbers of marine mammal exposures above Level A harassment and Level B harassment thresholds as a result of the planned activities.

Monopile Installation

JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) animal movement model was used to predict the probability of marine mammal exposure to impact pile driving sound generated by monopile installation. Sound exposure models like JASMINE use simulated animals (also known as "animats") to forecast behaviors of animals in new situations and locations based on previously documented behaviors of

those animals. The predicted 3D sound fields (*i.e.*, the output of the acoustic modeling process described earlier) are sampled by animats using movement rules derived from animal observations. The output of the simulation is the exposure history for each animat within the simulation.

The precise location of animats (and their pathways) are not known prior to a project, therefore, a repeated random sampling technique (Monte Carlo) is used to estimate exposure probability with many animats and randomized starting positions. The probability of an animat starting out in or transitioning into a given behavioral state can be defined in terms of the animat's current behavioral state, depth, and the time of day. In addition, each travel parameter and behavioral state has a termination function that governs how long the parameter value or overall behavioral state persists in the simulation.

The output of the simulation is the exposure history for each animat within the simulation, and the combined history of all animats gives a probability density function of exposure during the project. Scaling the probability density function by the real-world density of animals (Table 13) results in the mean number of animats expected to be exposed over the duration of the project. Due to the probabilistic nature of the process, fractions of animats may be predicted to exceed threshold. If, for example, 0.1 animats are predicted to exceed threshold in the model, that is interpreted as a 10-percent chance that one animat will exceed a relevant threshold during the project, or equivalently, if the simulation were re-run ten times, one of the ten simulations would result in an animat exceeding the threshold. Similarly, a mean number prediction of 33.11 animats can be interpreted as re-running the simulation where the number of animats exceeding the threshold may differ in each simulation but the mean number of animats over all of the simulations is 33.11. A portion of an individual marine mammal cannot be taken during a project, so it is common practice to round mean number animat exposure values to

integers using standard rounding methods. However, for low-probability events it is more precise to provide the actual values. For this reason, mean number values are not rounded.

Sound fields were input into the JASMINE model and animats were programmed based on the best available information to "behave" in ways that reflect the behaviors of the 15 marine mammal species expected to occur in the project area during the activity. The various parameters for forecasting realistic marine mammal behaviors (*e.g.*, diving, foraging, surface times, etc.) are determined based on the available literature (*e.g.*, tagging studies). When literature on these behaviors was not available for a particular species, it was extrapolated from a similar species for which behaviors would be expected to be similar to the species of interest. Please refer to the footnotes on Tables 16 and 17, and Appendix P2 of SFWF COP for a more detailed description of the species that were used as proxies when data on a particular species was not available. The parameters used in JASMINE describe animat movement in both the vertical and horizontal planes (*e.g.*, direction, travel rate, ascent and descent rates, depth, bottom following, reversals, inter-dive surface interval). More information regarding modeling parameters can be found in Denes *et al.* (2020b).

The mean numbers of animats that may be exposed to noise exceeding acoustic thresholds were calculated for two construction schedules, one representing the most likely schedule, and one representing a more aggressive, or maximum schedule (Denes *et al.*, 2019). The most likely schedule assumes that three foundations are installed per week with an average of one pile installed every other day. The maximum schedule assumes six monopile foundations are installed per week with one pile installation per day. Within each of the construction schedules, a single difficult-to-drive pile was included in the model assumptions to account for the potential for additional strikes (Denes *et al.*, 2019). Animats were modeled to move throughout the three-dimensional sound fields produced

by each construction schedule for the entire construction period. For PTS exposures, both SPL_{peak} and SPL_{cum} were calculated for each species based on the corresponding acoustic criteria. Once an animat is taken within a 24-hour period, the model does not allow it to be taken a second time in that same period but rather resets the 24-hour period on a sliding scale across 7 days of exposure. An individual animat's exposure levels are summed over that 24-hour period to determine its total received energy, and then compared to the threshold criteria. Potential behavioral exposures are estimated when an animat is within the area ensonified by sound levels exceeding the corresponding thresholds. It should be noted that the estimated numbers of individuals exceeding any of the thresholds is conservative because the 24-hour evaluation window allows individuals to be counted on multiple days (or can be interpreted as different individuals each 24-hour period) when in the real world it may in fact be the same individual experiencing repeated exposures (Denes *et al.*, 2019). Please note that animal aversion was not incorporated into the JASMINE model runs that were the basis for the take estimate for any species. See Appendix P2 of the SFWF COP for more details on the JASMINE modeling methodology, including the literature sources used for the parameters that were input in JASMINE to describe animal movement for each species that is expected to occur in the project area.

In summary, exposures were estimated in the following way:

1) The characteristics of the sound output from the pile-driving activities were modeled using the GRLWEAP (wave equation analysis of pile driving) model and JASCO's TDFD PDSM;

2) Acoustic propagation modeling was performed within the exposure model framework using FWRAM and BELLHOP, which combined the outputs of the source model with the spatial and temporal environmental context (*e.g.*, location, oceanographic conditions, seabed type) to estimate sound fields;

3) Animal movement modeling integrated the estimated sound fields with species-typical behavioral parameters in the JASMINE model to estimate received sound levels for the animals that may occur in the operational area; and

4) The number of potential exposures above Level A harassment and Level B harassment thresholds was calculated for each potential piling scenario (standard, maximum).

All scenarios were modeled with no sound attenuation and 6, 10, 12, and 15-dB sound attenuation. The results of marine mammal exposure modeling for the potentially more impactful maximum piling scenarios are shown in Tables 16 and 17, as these form the basis for authorized take.

Table 16. Modeled Potential Level A Harassment Exposures[1] Due to Impact Pile Driving Using the Maximum Design Scenario With the Inclusion of 1 Difficult-to-Drive pile and 0, 6, 10, 12, and 15-dB Broadband Attenuation

Species	0 dB attenuation		6 dB attenuation		10 dB attenuation		12 dB attenuation		15 dB attenuation	
	SEL_{cum}	SPL_{pk}	SEL_{cum}	SPL_{pk}	SEL_{cum}	SPL_{pk}	SEL_{cum}	SPL_{pk}	SEL_{cum}	SPL_{pk}
Low-Frequency Cetaceans										
Fin whale	7	< 1	3	< 1	1	< 1	1	< 1	< 1	< 1
Minke whale[2]	7	< 1	3	< 1	1	< 1	1	< 1	< 1	< 1
Sei whale[3]	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Humpback whale[2]	21	< 1	9	< 1	4	< 1	3	< 1	3	< 1
North Atlantic right whale[2]	4	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Blue whale	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Mid-Frequency Cetaceans										
Sperm whale	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Atlantic spotted dolphin[4]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Atlantic white-sided dolphin[4]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bottlenose dolphin	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Common dolphin[4]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Risso's dolphin[4]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Pilot whale[5]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
High-Frequency Cetaceans										
Harbor porpoise	33	23	4	7	1[7]	3	1	3	< 1	1
Pinnipeds in Water										
Gray seal[6]	6	< 1	1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Harbor seall	8	1	2	< 1	< 1	< 1	< 1	< 1	< 1	< 1

dB=decibel; SEL_{cum}=sound exposure level in units of dB referenced to 1 micropascal squared second; SPL_{pk}=peak sound pressure level in units of dB referenced to 1 micropascal.
[1]The maximum density available for any month was used for each species to estimate the maximum potential exposures (*i.e.*, exposure estimates for all species are not for the same month).
[2]Subset of fin whale behaviors used to approximate model parameters.

[3]Fin whale used as proxy species for exposure modeling.
[4]Subset of sperm whale and Atlantic spotted dolphin behaviors used to approximate model parameters.
[5]Subset of sperm whale behaviors used to approximate model parameters.
[6]Harbor seal used as proxy species for exposure modeling.
[7]Calculated exposures with 10 dB for harbor porpoises were < 1 but >0.5; therefore they were rounded up to the nearest whole number.

Again, only the estimated Level B harassment exposures for the maximum design impact pile driving of monopiles schedule are presented here (Table 17).

Table 17. Modeled Potential Level B Harassment Exposures[1] Due to Impact Pile Driving Using the Maximum Design Scenario With 1 Difficult-to Drive pile and 0, 6, 10, 12, and 15-dB broadband attenuation

Species	Level B Exposures by Noise Attenuation Level				
	0 dB attenuation	6 dB attenuation	10 dB attenuation	12 dB attenuation	15 dB attenuation
Low-Frequency Cetaceans					
Fin whale	21	10	6	5	4
Minke whale[2]	27	15	10	8	6
Sei whale[3]	< 1	< 1	< 1	< 1	< 1
Humpback whale[2]	26	13	8	7	6
North Atlantic right whale[2]	16	7	4	3	3
Blue whale	< 1	< 1	< 1	< 1	< 1
Mid-Frequency Cetaceans					
Sperm whale	< 1	< 1	< 1	< 1	< 1
Atlantic spotted dolphin[4]	6	3	2	1	< 1
Atlantic white-sided dolphin[4]	322	152	107	85	48
Bottlenose dolphin	1,261	459	197	148	73
Common dolphin[4]	2	1	< 1	< 1	< 1
Risso's dolphin[4]	212	85	43	34	14
Pilot whale[5]	< 1	< 1	< 1	< 1	< 1
High-Frequency Cetaceans					
Harbor porpoise	272	129	78	67	40
Pinnipeds in Water					
Gray seal[6]	307	116	60	52	28
Harbor seal	319	119	54	45	28

dB=decibel
[1]The maximum density available for any month was used for each species to estimate the maximum potential exposures (*i.e.*, exposure estimates for all species are not for the same).
[2]Subset of fin whale behaviors used to approximate model parameters.
[3]Fin whale used as proxy species for exposure modeling.
[4]Subset of sperm whale and Atlantic spotted dolphin behaviors used to approximate model parameters.
[5]Subset of sperm whale behaviors used to approximate model parameters.
[6]Harbor seal used as proxy species for exposure modeling.

Although exposures are presented according to a range of attenuation levels, take numbers are based on an assumption of 10-dB attenuation and are shown below in Table 18. South Fork Wind considers an attenuation level of 10-dB achievable using a dBBC, which is the most likely noise mitigation technology that will be used during construction

of SFWF. Recently reported *in situ* measurements during installation of monopiles (~8 m) for more than 150 WTGs in comparable water depths (> 25 m) and conditions in Europe indicate that attenuation of 10-dB is readily achieved (Bellmann, 2019; Bellmann *et al.*, 2020) using single BBCs for noise mitigation. Designed to gather additional data regarding the efficacy of BBCs, the Coastal Virginia Offshore Wind (CVOW) pilot project systematically measured noise resulting from the impact driven installation of two 7.8-m monopiles, one installation using a dBBC and the other installation using no noise mitigation system (CVOW, unpublished data). Although many factors contributed to variability in received levels throughout the installation of the piles (*e.g.*, hammer energy, technical challenges during operation of the dBBC), reduction in broadband SEL using the dBBC (comparing measurements derived from the mitigated and the unmitigated monopiles) ranged from approximately 9-15 dB. The effectiveness of the dBBC as a noise mitigation system was found to be frequency-dependent, reaching maximum efficacy around 1 kHz; this finding is consistent with other studies (*e.g.*, Bellman, 2014; Bellman *et al.*, 2020). The noise measurements were incorporated into a dampened cylindrical transmission loss model to estimate ranges to Level A harassment and Level B harassment isopleths. The ranges to Level A harassment and Level B harassment isopleths estimated for the monopile with the dBBC were more than 90 percent and 74 percent smaller than those estimated for the unmitigated pile, respectively (CVOW unpublished data).

South Fork Wind conservatively based their exposure modeling on the maximum piling scenario, including one difficult-to-drive monopile (out of 16) and a compressed buildout schedule (16 piles installed over 20 days).

In addition, the acoustic modeling scenario represents only that which produced the largest harassment zones, and does not reflect all the mitigation measures that must be employed during piling operations to reduce the ensonified zone or increase mitigation

actions, which may reduce take (see the **Mitigation** section for details).

Variability in monthly species densities is not considered in South Fork Wind's take estimates for impact pile driving of monopiles, which are based on the highest mean density value for any month for each species. Given that all monopile installations will potentially occur within an approximately 30-day timeframe, it is unlikely that maximum monthly densities would be encountered for all species.

Finally, start delays and shutdowns of monopile installation are not considered in the exposure modeling parameters for monopile driving. However, South Fork Wind must delay impact pile driving of monopiles if a NARW is observed at any distance prior to initiating pile driving to avoid take, and if any other marine mammal is observed entering or within the respective clearance zone during the clearance period. If monopile installation has already commenced, South Fork Wind is required to shutdown if a NARW is sighted at any distance or detected via PAM within 2 km of the monopile location, and if any other marine mammal enters its respective shutdown zone (unless South Fork Wind and/or its contractor determines shutdown is not practicable due to an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals). There are two scenarios, approaching pile refusal and pile instability, where this imminent risk could be a factor. These scenarios are considered unlikely and it is expected that shutdowns will predominantly be practicable during operations. See **Mitigation** section for shutdown procedural details.

Although exposure modeling for monopile installations indicated that take by Level A harassment (PTS) is only expected for a three species of baleen whales (fin whale, minke whale, and humpback whale), South Fork Wind requested, and NMFS has authorized, take, by Level A harassment, of one sei whale based on 1) rare observations of sei whales in/near the Lease Area during prior monitoring efforts, and 2) difficulty distinguishing fin and sei whales at sea (observers sometimes report a fin/sei complex). In

addition, South Fork Wind requested authorization of take, by Level B harassment, equal to the mean group size for several species, based on the following: seals, Herr *et al.*, (2009); long-finned pilot whale, Kenney and Vigness-Raposa (2010); sperm whale, and Risso's dolphin, Barkaszi and Kelly (2018). NMFS generally agrees that this approach is appropriate in cases where instantaneous exposure is expected to result in harassment (*e.g.*, Level B harassment) and calculated take estimates are either zero or less than the group size. Upon further review of scientific literature, NMFS has increased take, by Level B harassment, of long-finned pilot whales from 12 to 20, based on the largest reported group size (n=20; CETAP, 1982). Similarly, NMFS increased take, by Level B harassment, of Atlantic spotted dolphins from 2 to 13 based on Barkaski and Kelly (2018); this group size is similar to average group size estimated from observations of Atlantic spotted dolphins within or near the project area (n=10), as reported in Smultea (2020). Common dolphins are frequently sighted in the project area, although the average group size varies by season (AMAPPS, 2021). During previous monitoring efforts in or near the SFWF and SFEC, the average group size ranged from 9.6 (CSA, 2021) to 35 (AMAPPS 2021). To account for the frequency of occurrence in the project area, NMFS conservatively increased take of common dolphins, by Level B harassment, from 197 to 560 by multiplying the largest reported group size (35; AMAPPS, 2021) by the number of days on which impact pile driving of monopiles may occur (n=16). AMAPPS (2021) reports the largest average group size for bottlenose dolphins (n=21.6) among the literature reviewed (DoN, 2017; Smultea, 2020; CSA, 2021; AMAPPS, 2021). NMFS increased take, by Level B harassment, of bottlenose dolphins from 43 to 346 by multiplying group size (n=21.6; AMAPPS, 2021) by the number of days on which monopile installation may occur (n=16). Finally, as described in the **Comments and Responses** and **Changes from Proposed to Final IHA** sections, one take, by Level B harassment, of a blue whale was originally proposed for authorization. However, given

the lack of observations of blue whales within or near the project area and the species' preference for deeper water and bathymetric features such as continental shelf edges, NMFS has determined that the potential for Level B harassment for this species is *de minimus* and NMFS has not authorized take of a blue whale, by Level B harassment. Please see Table 18 for the number of takes proposed and authorized, by species, incidental to impact pile driving of monopiles.

Table 18. Proposed and Authorized Level A Harassment and Level B Harassment Take Of Marine Mammals Resulting From Impact Pile Driving Of Up to 16, 11-m Monopiles With Inclusion Of a Single Difficult-to-Drive Pile At South Fork Wind Farm Assuming 10-dB Broadband Sound Attenuation

Species/Stock	Abundance[1] Estimate	Proposed Take[2]		Authorized Take[3]	
		Level A Harassment	Level B Harassment	Level A Harassment	Level B Harassment
Fin whale	6,802	1	6	1	6
Minke whale	21,968	1	10	1	10
Sei whale	6,292	1(0)	1	1	1
Humpback whale	1,396	4	8	4	8
North Atlantic right whale	368	0	4	0	4
Sperm whale	4,349	0	3(0)	0	3
Long-finned pilot whale	39,215	0	2	0	20
Atlantic spotted dolphin	39,921	0	2	0	13
Atlantic white-sided dolphin	93,233	0	107	0	107
Common dolphin	172,974	0	197	0	560
Risso's dolphin	35,215	0	30(1)	0	30
Bottlenose dolphin	62,851	0	43	0	346
Harbor porpoise	95,543	0	78	0	78
Gray seal	27,300	0	60	0	60
Harbor seal	61,336	0	54	0	54

[1] The best available abundance estimates are derived from the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021). NMFS stock abundance estimate for gray seals in Table 3 applies to U.S. population only; actual stock abundance is approximately 451,431.

[2] Parentheses denote animal exposure model estimates. For species with no modeled exposures for Level A harassment or Level B harassment, proposed takes are based on mean group sizes (*e.g.*, sei whale, long-finned pilot whale: Kenney and Vigness-Raposa (2010); sperm whale, Risso's dolphin: Barkaszi and Kelly, (2018)).
[3] Authorized take is based on largest group size reported from observations in or near the project area (*e.g.*, long-finned pilot whale: CETAP 1982; Atlantic spotted dolphin: Barkasky and Kelly (2018); common dolphin, bottlenose dolphin: AMAPPS 2021).

Cofferdam Installation and Removal

Animal movement and exposure modeling was not used to determine potential exposures from vibratory pile driving. Rather, the modeled acoustic ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds were used to calculate the area around the cofferdam predicted to be ensonified daily to levels that exceed the thresholds, or the Zone of Influence (ZOI). ZOI is calculated as the following:

$$ZOI = \pi r^2,$$

where r is the linear acoustic range from the source to the isopleth corresponding to Level A harassment or Level B harassment thresholds. This area was adjusted to account for the portion of the ZOI truncated by the coastline of Long Island, NY.

The daily area was then multiplied by the maximum monthly density of a given marine mammal species. Roberts *et al.* (2018) produced density models for all seals, but did not differentiate by seal species. Because the seasonality and habitat use by gray seals roughly overlaps with that of harbor seals in the project area, it was assumed that the mean annual density of seals could refer to either of the respective species and was, therefore, divided equally between the two species.

Finally, the resulting value was multiplied by the number of activity days that contain the potential duration of actual vibratory pile driving (36 hours total) which is, for cofferdam installation and removal, conservatively estimated as two days. Modeling of the Level A harassment exposures resulting from an 18-hour period of vibratory pile driving for installation and another 18-hour period for removal resulted in less than one exposure for all species for each month between October 1 and May 31. South Fork Wind

plans to install a cofferdam or casing pipe, if required, as one of the first activities in the construction schedule; removal could occur at any time through the expiration of the IHA. Modeled potential Level B harassment exposures resulting from installation and removal of the cofferdam are shown in Table 19.

Table 19. Modeled Level B harassment Exposures Resulting From Vibratory Pile Driving to Install and Remove the Cofferdam

Species	Jan	Feb	Mar	Apr	May	Oct	Nov	Dec
Fin whale	0	0	1	2	1	1	0	0
Minke whale	2	3	3	0	0	0	2	2
Sei whale	0	0	0	0	0	0	0	0
Humpback whale	1	1	1	0	0	0	0	1
North Atlantic right whale	6	6	5	3	1	0	1	3
Atlantic white-sided dolphin	0	0	0	1	1	1	1	1
Common dolphin	1	0	0	1	3	3	4	3
Bottlenose dolphin	289	123	65	197	1,509	2,007	1,088	337
Harbor porpoise	3	2	2	5	3	11	1	2
Gray seal	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305
Harbor seal	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305

Maximum 18-hour period of vibratory pile driving for installation and 18-hour period for removal will be separated by at least 24 hours of no vibratory sound source operating at the cofferdam.

Modeled vibratory pile-driving activities for the SFEC (SFWF COP Appendix J1 [Denes *et al.,* 2018]) resulted in mean acoustic ranges to the Level A harassment isopleth for low-frequency cetaceans (LFCs), ranging from 742 m for 6 hours of piling to 1,470 m for 18 hours of piling (Denes *et al.,* 2018). Maximum acoustic ranges to Level A harassment isopleths for other marine mammal hearing groups are all under 103 m. Level A harassment exposures are not expected, due to relatively low population densities of LFC species near the installation area, animal movement and required accumulation periods (Denes *et al.*, 2019), the short duration of vibratory pile driving, and mitigation measures (including a 1,500 m shutdown zone for LFCs; see **Mitigation** section).

Vibratory pile driving during cofferdam installation and removal for the SFEC HDD exit pit does have the potential to elicit behavioral responses in marine mammals. However, predicting Level B harassment exposure estimates resulting from vibratory pile driving is complicated by the nearshore location, short duration of cofferdam installation

and removal, and static species density data that are not indicative of animals transiting the nearshore environment. Marine mammal densities were estimated from the 10 x 10 km habitat density block from Roberts *et al.* (2016) and Roberts *et al.* (2018) that contained the anticipated location of the temporary cofferdam. However, density estimates are not provided for the area adjacent to the shoreline, although some density blocks do intersect the shore. Due to this structure, densities are artificially weighted to the nearest 100 km^2 offshore and do not adequately represent the low numbers expected for some groups like large whales. In addition, the species densities represented in the Roberts *et al.* (2016) and Robert *et al.* (2018) are provided as monthly estimates and are, therefore, not indicative of a single-day distribution of animals within the potential ensonified zone. The modeled range to the behavioral harassment isopleth extends beyond 36 km from the source (Table 11); despite this extensive Level B harassment zone, only bottlenose dolphin, harbor seal, and gray seal exposure estimates are comparatively large. However, the relatively low densities of most species nearshore, the seasonality of occurrence, and the transitory nature of marine mammals coupled with the small period of vibratory pile driving significantly reduces the risk of behavioral harassment exposures. In addition, marine mammal species in this region are not expected to remain in proximity to the cofferdam location for an extended amount of time. Although the modeled Level B harassment exposure estimates for harbor and gray seals were relatively large (1,305), seals are only expected to be seasonally present in the region, and there are no known rookeries documented near the cofferdam location. Seals typically haul-out for some portion of their daily activities, often in large groups (Hayes *et al.*, 2020); however, the in-water median group size is estimated to be 1-3 animals, depending on the distance to shore (Herr *et al.*, 2009), with larger groups typically being associated with direct proximity to a haul-out site. There are a few documented haul-out sites around Long Island, New York; the nearest site is Montauk Point, approximately 20

km northeast of the northern potential cofferdam location, where seals are primarily observed in winter (CRESLI, 2019). Potential exposures of offshore bottlenose dolphins varied substantially across the construction months, with a minimum number of potential Level B harassment exposures in March (65) and a maximum in October (2,007). The impact of vibratory pile driving on this species (and both seal species) will be largely dependent on the timing of the installation and removal of the cofferdam.

Given the possibility that vibratory pile driving (for installation and removal of the cofferdam, or the casing pipe support piles) could occur anytime in the construction schedule, the maximum modeled exposure across months for each species (Table 19) was used to conservatively predict take numbers and assess impacts resulting from vibratory pile driving (Table 20). However, in response to a comment from the Commission on the proposed IHA and as described in the **Changes from Proposed IHA to Final IHA,** NMFS has increased take, by Level B harassment, of humpback whales, white-sided dolphins, and common dolphins. Please see Table 20 for all proposed and authorized take, by Level B harassment, incidental to vibratory pile driving.

Table 20. Proposed and Authorized Level B Harassment Take Resulting From Vibratory Pile Driving

Species/Stock	Population Estimate[1]	Proposed Level B Harassment Take	Authorized Level B Harassment Take
Fin whale	6,802	2	2
Minke whale	21,968	3	3
Sei whale	6,292	0	0
Humpback whale	1,396	1	10
North Atlantic right whale	368	6	6
Atlantic white-sided dolphin	93,233	1	50

Common dolphin	172,974	4	210
Bottlenose dolphin	62,851	2,007	2,007
Harbor porpoise	95,543	11	11
Gray seal	27,300	1,305	1,305
Harbor seal	61,336	1,305	1,305

[1] The best available abundance estimates are derived from the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021). NMFS' stock abundance estimate for gray seals in Table 3 applies to U.S. population only; actual stock abundance is approximately 451,431.

Construction Surveys

Potential exposures of marine mammals to acoustic impacts from construction survey activities were estimated using an approach similar to that described for installation and removal of a cofferdam. For construction surveys, however, the ZOI was calculated as follows:

$$ZOI = 2rd + \pi r^2$$

where r is the linear acoustic range from the source to the largest estimated ranges to Level A harassment (36.5 m) and Level B harassment (141 m) isopleths, and d is the survey trackline distance per day (70 km).

The daily area was then multiplied by the mean annual density of a given marine mammal species. Finally, the resulting value was multiplied by the number of survey days (60).

Modeled ranges to isopleths corresponding to the Level A harassment threshold are very small (< 1 m) for three of the four marine mammal functional hearing groups that may be impacted by the planned activities (*i.e.*, low-frequency and mid-frequency cetaceans, and phocid pinnipeds; see Table 12). Based on the extremely small Level A harassment zones for these functional hearing groups, the potential for species within these functional hearing groups to be taken by Level A harassment is considered so low as to be discountable. These three functional hearing groups encompass all but one of the

marine mammal species listed in Table 3 that may be impacted by the planned activities. There is one species (harbor porpoise) within the high-frequency functional hearing group that may be impacted by the planned activities. However, the largest modeled range to the Level A harassment isopleth for the high-frequency functional hearing group was only 36.5 m (Table 12). More importantly, Level A harassment would also be more likely to occur at close approach to the sound source, or as a result of longer duration exposure to the sound source. Mitigation measures (including a 100-m shutdown zone for harbor porpoises) are expected to minimize the potential for exposure to HRG sources that would result in Level A harassment. In addition, harbor porpoises are a notoriously shy species, known to avoid vessels, and would be expected to avoid a sound source prior to that source reaching a sound level that would result in injury (Level A harassment). Therefore, NMFS has determined that the potential for take by Level A harassment of harbor porpoises is so low as to be discountable. The modeled Level B harassment exposures of marine mammals resulting from construction survey activities are shown in Table 21.

Table 21. Modeled Level B Harassment Exposures Resulting From Construction Surveys Of the SFWF and SFEC

Species	Population Estimate[1]	Estimated Level B harassment exposures
Fin whale	6,802	3
Minke whale	21,968	1
Sei whale	6,292	< 1
Humpback whale	1,396	1
North Atlantic right whale	368	3
Sperm whale	4,349	< 1
Atlantic spotted dolphin	39,215	< 1
Atlantic white-sided dolphin	93,233	26

Common dolphin	172,974	47
Bottlenose dolphin	62,851	28
Risso's dolphin	35,215	< 1
Long-finned pilot whale	39,215	4
Harbor porpoise	95,543	43
Gray Seal	27,300	14
Harbor seal	61,336	14

[1] The best available abundance estimates are derived from the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021). NMFS' stock abundance estimate for gray seals in Table 3 applies to U.S. population only; actual stock abundance is approximately 451,431.

The proposed and authorized number of takes by Level B harassment resulting from construction surveys are shown in Table 22. Again, as NMFS has determined that the likelihood of take of any marine mammals in the form of Level A harassment occurring as a result of the planned surveys is so low as to be discountable, and South Fork Wind did not request any take by Level A harassment associated with construction surveys, NMFS does not authorize take by Level A harassment of any marine mammals.

The seasonal mean number of minke whales sighted during marine site characterization surveys in or near the Lease Area in 2017 and 2018 was 19; therefore, South Fork Wind increased the number of takes requested for minke whales from 1 to 19. Preliminary PSO reports from similar surveys in or near the Lease Area in 2019 and 2020 show a high number of common dolphin detections within the estimated Level B harassment zones. Using a mean group size of 25 (based on sightings during monitoring efforts in the project area), South Fork Wind multiplied the mean group size by the number of Level B harassment exposures modeled (47) to produce the number of takes, by Level B harassment, they requested (1,175). There were zero exposures estimated for several species; however, as a precautionary measure, South Fork Wind requested, and NMFS has authorized, Level B harassment takes for those species based on published values of mean group sizes (Atlantic spotted dolphin, Risso's dolphin, Barkaszi and Kelly

(2018)). After review of the scientific literature, NMFS has increased authorized take, by Level B harassment, of long-finned pilot whales from 4 to 20, based on the largest reported group size (CETAP 1982). Please see Table 22 for all proposed and authorized take, by Level B harassment, incidental to construction surveys.

Table 22. Proposed and Authorized Level B Harassment Take Resulting From Construction Surveys Of the SFWF and SFEC

Species/Stock	Population Estimate[1]	Proposed Level B Harassment Take[2]	Authorized Level B Harassment Take
Fin whale	6,802	3	3
Minke whale	21,968	19 (1)	19
Sei whale	6,292	1 (0)	1
Humpback whale	1,396	1	1
North Atlantic right	368	3	3
Sperm whale	4,349	3 (0)	3
Long-finned pilot	39,215	4	20
Atlantic spotted	39,921	13 (0)	13
Atlantic white-sided	93,233	26	26
Common dolphin	172,974	1,175 (47)	1,175
Risso's dolphin	35,493	30 (0)	30
Bottlenose dolphin	62,851	28	28
Harbor porpoise	95,543	43	43
Gray seal	27,300	14	14
Harbor seal	61,336	14	14

[1] The best available abundance estimates are derived from the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021). NMFS stock abundance estimate for gray seals in Table 3 applies to U.S. population only; actual stock abundance is approximately 451,431.
[2] The modeled number of takes is shown in parentheses.

Combined Activity Authorized Take

The number of takes, by Level A harassment and Level B harassment, authorized incidental to the combined activities (impact pile driving of monopiles using a noise mitigation system, vibratory pile driving, and construction surveys) are provided in Table

23. NMFS also presents the percentage of each stock taken based on the total amount of take. The mitigation and monitoring measures provided in the **Mitigation** and **Monitoring and Reporting** sections are activity-specific and are designed to minimize acoustic exposures to marine mammal species.

The take numbers NMFS has authorized (Table 23) are considered conservative for the following key reasons:

- Authorized take numbers for impact pile driving of monopiles assume a maximum piling schedule (16 monopiles installed in 20 days);
- Authorized take numbers for vibratory pile driving assume that a sheet pile temporary cofferdam will be installed (versus the alternative installation of a casing pipe for which less take is expected);
- Authorized take numbers for impact pile driving of monopiles are conservatively based on maximum densities across the planned construction months;
- Authorized Level A harassment take numbers do not fully account for the likelihood that marine mammals will avoid a stimulus when possible before that stimulus reaches a level that would have the potential to result in injury;
- Authorized take numbers do not fully account for the effectiveness of mitigation and monitoring measures in reducing the number of takes to effect the least practicable adverse impact (with the exception of the seasonal restriction on impact pile driving of monopiles, which is accounted for in the authorized take numbers).

Table 23. Authorized Take By Level A Harassment and Level B Harassment For All Activities[1] Conducted During SFWF and SFEC Construction

Species/Stock	Population[2] Estimate	Authorized Take for All Construction Activities		Total Authorized Take (Level A + Level B)	Percentage of Population or Stock (%)[3]
		Level A Harassment Take	Level B Harassment Take		

Fin whale	6,802	1	11	12	0.28
Minke whale	21,968	1	32	33	0.15
Sei whale	6,292	1	2	3	0.06
Humpback whale	1,396	4	19	23	1.65
North Atlantic right whale	368	0	13	13	3.53
Sperm whale	4,349	0	6	6	0.14
Pilot whales (long-finned)	39,215	0	40	40	0.10
Atlantic spotted dolphin	39,921	0	26	26	0.07
Atlantic white-sided dolphin	93,233	0	183	183	0.20
Common dolphin	172,974	0	1,945	1,945	1.12
Risso's dolphin	35,215	0	60	60	0.17
Bottlenose dolphin	62,851	0	2,381	2,318	3.79
Harbor porpoise	95,543	0	132	132	0.14
Gray seal	451,431	0	1,379	1,379	0.31
Harbor seal	61,336	0	1,373	1,373	1.81

[1] Activities include impact pile driving of monopiles using a noise mitigation system, vibratory pile driving, and construction surveys.
[2] The best available abundance estimates are derived from the NMFS' 2021 Draft SARs (Hayes *et al.*, 2021). NMFS' stock abundance estimate for gray seals in Table 3 applies to U.S. population only; actual stock abundance is approximately 451,431.
[3] Calculations of percentage of stock taken are based on the best available abundance estimate.

Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, NMFS carefully considers two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned), the likelihood of effective implementation (probability implemented as planned), and;

(2) The practicability of the measures for applicant implementation, which may consider such things as cost and impact on operations.

The mitigation strategies described below are consistent with those required and successfully implemented under previous incidental take authorizations issued in association with in-water construction activities (*e.g.*, ramp-up, establishing harassment zone, implementing shutdown zones, etc.). Additional measures have also been incorporated to account for the fact that some of the planned activities would occur offshore. Modeling was performed to estimate ensonified areas or ZOIs; these ensonified area values were used to inform mitigation measures for all analyzed construction activities to minimize Level A harassment and Level B harassment to the extent possible, while providing estimates of the areas within which Level B harassment might occur. Several measures have been added or modified since the proposed IHA was published, and are identified and described in detail below.

In addition to the specific measures described later in this section, South Fork Wind must conduct briefings for construction supervisors and crews, the marine mammal and acoustic monitoring teams, and South Fork Wind staff prior to the start of all pile-driving and construction survey activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, the marine mammal monitoring protocols, and operational procedures. South Fork Wind must use available sources of

information on NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, monitoring of Coast Guard VHF Channel 16 throughout the day to receive notifications of any sightings, and information associated with any DMAs. This measure was not included in the proposed IHA, but affords increased protection of NARWs by raising awareness of NARW presence in the area through ongoing visual and passive acoustic monitoring efforts (outside of South Fork Wind's efforts), and allows for planning of construction activities, when practicable, to minimize potential impacts on NARWs.

Monopile installation

Seasonal Restriction on Impact Pile Driving of Monopiles

Based on the best available information (Kraus *et al.*, 2016; Roberts *et al.*, 2017, 2020), the highest densities of NARWs in the project area are expected from January through April. As described in the proposed IHA, impact pile driving of monopiles must not occur January 1 through April 30. In addition, impact pile driving of monopiles must not occur in December unless unanticipated delays due to weather or technical problems, notified to and approved by BOEM, arise that necessitate extending impact pile driving of monopiles into December. NMFS is requiring this seasonal restriction to minimize the potential for NARWs to be exposed to noise incidental to impact pile driving of monopiles. However, South Fork Wind's revised project schedule includes installation of a cofferdam or casing pipe (in preparation for HDD) as the first construction activity during the period of effectiveness of the IHA (starting November 15, 2022). Therefore, based on South Fork Wind's construction schedule, impact pile driving of monopiles will not occur from November 15, 2022 through April 30, 2023. Impact pile driving of monopiles will occur between May 1, 2023 and November 14, 2023. No more than one monopile will be driven per day. Monopiles must be no larger than 11 m in diameter. For all monopiles, the minimum amount of hammer energy necessary to effectively and

safely install and maintain the integrity of the monopiles must be used. Hammer energies must not exceed 4,000 kJ.

Clearance and Shutdown Zones

South Fork Wind must use PSOs and PAM PSOs to establish clearance zones around the impact pile-driving location to ensure these zones are clear of marine mammals prior to the start of impact pile driving. The purpose of "clearance" of a particular zone is to prevent potential instances of auditory injury, and more severe behavioral disturbance as a result of exposure to impact pile-driving noise, by delaying the activity before it begins if marine mammals are detected within certain pre-defined distances of the impact pile-driving vessel. The primary goal in this case is to prevent auditory injury (PTS) of NARWs and reduce the risk of PTS for other marine mammals where there is potential for it to occur. The clearance zones are larger than the modeled ranges to isopleths (based on $ER_{95percent}$ SEL_{cum}), assuming 10-dB attenuation, corresponding to Level A harassment thresholds for all marine mammal species except humpback whales. These zone sizes vary by species and are shown in Tables 24 and 25. All distances to the perimeter of clearance zones are the radii from the center of the pile. The clearance zones for large whales (excluding humpback whales), harbor porpoises, and seals are based on the maximum range to the Level A harassment isopleth plus a 20-percent buffer, rounded up for PSO clarity. For mid-frequency cetaceans, modeled ranges to the Level A harassment isopleth are 0 m, based on $ER_{95percent}$ SEL_{cum} (assuming 10-dB attenuation). Although the Level A harassment zones based on SPL_{peak} are small for mid-frequency cetaceans, clearance zones are defined using a precautionary distance of 100-m, and will extend to that distance or just beyond the placement of the noise mitigation system, whichever is further.

The Level A harassment zone (based on $ER_{95percent}$ SEL_{cum}) is larger for humpback whales than other low-frequency baleen whales because the animal movement

modeling used to estimate the associated range to the Level A harassment isopleth relies on behavior-based exposures with no aversion (based on the best available data that inform the animat models). Specific movement parameters help drive the larger zone size for humpback whales, including a modeled preference for slightly deeper water than the depths in the SFWF. This modeled preference resulted in fewer exposures, but each exposure was farther from the impact piling location, producing the larger Level A harassment zone. While the clearance zone (2,200 m) for humpback whales is smaller than the Level A harassment zone (3,642 m), visual monitoring must be conducted from both the impact pile driving vessel and a secondary, smaller vessel (on which dedicated PSOs must be deployed) surveying the circumference of the pile-driving vessel at a radius approximate to the clearance zone for non-NARW large whales (2,200 m). NMFS expects that, depending on visibility conditions, this additional visual monitoring will facilitate detection of humpback whales within the Level A harassment zone (3,642 m) for the species, beyond the farthest extent of the clearance zone.

The NARW clearance zone is conservatively based on the Level B harassment zone (4,684 m), rounded up to 5,000 m for PSO clarity. PSOs and PAM PSOs may use a combination of visual observation and real-time PAM to clear this zone (see **Monitoring and Reporting**); however, as noted in the **Changes from Proposed IHA to Final IHA**, the 2.2-km minimum visibility zone is defined as the area over which PSOs must be able to clearly observe marine mammals, including NARWs, to begin the clearance process. When visibility conditions permit (*i.e.*, on clear days), PSOs will be able to detect marine mammals at farther distances. Under all circumstances, a visual detection of a NARW at any distance by a PSO on the impact pile-driving or dedicated PSO vessel will trigger a delay. Further, any large whale sighted by a PSO within 2,000 m of the pile that cannot be identified to species must be treated as if it were a NARW, triggering a delay in impact pile driving of monopiles. In addition, an acoustic detection of a NARW localized

to a position within the 5-km radius clearance zone will trigger a delay. Finally, the PAM system will likely be capable of detecting NARW over an approximately 10-km radius from the pile, providing PAM PSOs with the capacity to monitor an area larger than the NARW clearance zone. Detections of potential NARW vocalizations originating from outside the PAM clearance zone will provide situational awareness to PSOs.

Table 24. Impact Pile Driving of Monopiles: Radial Distances (m) to Level A Harassment and Level B Harassment Isopleths, Required Clearance and Shutdown Zones, and Vessel Separation Distances.

Species	Level A Harassment Zone (SEL)	Level A Harassment Zone (PK)	Level B Harassment Zone	Clearance Zone	Shutdown Zone	Vessel Separation Distance from Marine Mammals
Low-frequency Cetaceans						
Fin whale[E]	1,756	≤10	4,684	2,200	2,000	100
Minke whale	1,571	≤10	4,684	2,200	2,000	100
Sei whale[E]	1,769	≤10	4,684	2,200	2,000	100
Humpback whale	3,642	≤10	4,684	2,200	2,000	100
North Atlantic right whale[E]	1,621	< 10	4,684	See Table 25	See Table 26	500
Mid-frequency Cetaceans						
Sperm whale[E]	-	≤10	4,684	2,200	2,000	100
Atlantic spotted dolphin	-	≤10	4,684	100	50	50
Atlantic white-sided dolphin	-	≤10	4,684	100	50	50
Common dolphin	-	≤10	4,684	100	50	50
Risso's dolphin	-	≤10	4,684	100	50	50
Bottlenose dolphin	-	≤10	4,684	100	50	50
Long-finned pilot whale	-	≤10	4,684	100	50	50
High-frequency Cetaceans						
Harbor porpoise	365	243	4,684	450	450	50
Phocid Pinnipeds in Water						
Gray seal	117	12	4,684	150	150	50
Harbor seal	85	12	4,684	150	150	50

[1] Upon receipt of an interim SFV report, NMFS may adjust the zones to reflect SFV measurements. However, minimum visibility zone will not be decreased, and zones for fin, sei, and sperm whales must not be decreased to a size less than 1 km. Zone sizes for NARWs must not be reduced.
[2] dB=decibel; SEL=cumulative sound exposure level; PK=peak sound pressure level

[2]SEL values are the 95% Exposure Ranges ($ER_{95\%}$) and assume 10-dB attenuation
[E] ESA-listed

Table 25. Required NARW Clearance and Real-Time PAM Monitoring Zones (Radial Distances From the Pile) For Monopile Installation

Minimum Visibility Zone[1,2,3]	PAM Clearance Zone[4]	PAM Monitoring Zone[5]
2.2 km	5 km	10 km
[1] Defined as the area over which PSOs must be able to clearly observe marine mammals, including NARWs, to begin clearance process. This zone size cannot be reduced. [2] A visual detection of a NARW at any distance from the pile by a PSO on the pile-driving vessel or dedicated PSO vessel triggers a delay in pile driving. [3] Any large whale sighted by a PSO within 2,000 m of the pile that cannot be identified to species must be treated as if it were a NARW. [4] A confirmed PAM detection of a NARW within the PAM clearance zone must be treated as a visual detection, triggering a delay in pile driving. [5] Calls detected outside of the PAM clearance zone must be reported to the lead PSO immediately for situational awareness, but will not trigger a delay in pile driving. [6] Zone sizes for NARWs must not be decreased.		

Table 26. Required NARW Shutdown Zones for Monopile Installation

NARW Shutdown Zone[1,2] (Visual and PAM)	
Visual	**PAM**
Any distance	2 km
[1] If NARW is sighted at any distance, a shutdown of pile driving must be implemented when practicable, as described under Condition 4(a)(ix)(1-3) of this IHA. [2] A confirmed PAM detection of a NARW within the PAM shutdown zone must be treated as a visual detection, triggering a shutdown of pile driving. [3] Zone sizes for NARWs must not be decreased.	

Prior to the start of impact pile driving of monopiles, both visual and PAM (for NARWs) clearance zones will be monitored for 60 minutes to ensure that they are clear of the relevant species of marine mammals. The entire minimum visibility zone must be visible (*i.e.*, not obscured by dark, rain, fog, etc.) for a full 30 minutes immediately prior to commencing impact pile driving. Impact pile driving may only commence once PSOs and PAM PSOs have declared the respective clearance zones clear of marine mammals. If a marine mammal is observed approaching or entering the relevant clearance zones prior to the start of impact pile driving, pile-driving activity must be delayed until either the marine mammal has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, 30 minutes have elapsed without re-detection of the animal in the case of mysticetes (including NARWs), sperm whales, Risso's dolphins

and pilot whales, or 15 minutes have elapsed without re-detection of the animal in the case of all other marine mammals. For NARWs, there is an additional requirement that the clearance zone may only be declared clear if no confirmed NARW acoustic detections (in addition to visual) have occurred during the 30-minute monitoring period.

The shutdown zones for non-NARW large whales, harbor porpoises, and seals are based on the maximum Level A harassment zone for each group (excluding humpback whales), increased by a 10-percent buffer and rounded up for PSO clarity (Table 24). Similar to clearance zones, mid-frequency cetacean (except sperm whale) shutdown zones will extend to the larger of two distances: 50 m, or just outside the noise mitigation system. For NARWs, a visual detection at any distance by a PSO (from the impact pile-driving vessel or dedicated PSO vessel) or acoustic detection localized to a position within 2,000 m of the pile will trigger shutdown of impact pile driving (Table 26).

If a species for which authorization has not been granted, or, a species for which authorization has been granted but the authorized number of takes has been met, approaches or is observed within the Level B harassment zone, impact pile-driving activities must be shut down immediately or delayed if impact pile driving has not commenced. Impact pile driving must not commence or resume until the animal has been confirmed to have left the Level B harassment zone on its own volition, or a full 30 minutes have elapsed with no further sightings.

Soft Start of Impact Pile Driving

The use of a soft start procedure is believed to provide additional protection to marine mammals by warning them, or providing them with a chance to leave the area prior to the hammer operating at full capacity. Soft start typically involves initiating hammer operation at a reduced energy level (relative to full operating capacity) followed by a waiting period. South Fork Wind must utilize a soft start protocol for impact pile driving of monopiles by performing 4-6 strikes per minute at 10 to 20 percent of the

maximum hammer energy, for a minimum of 20 minutes. NMFS notes that it is difficult to specify a reduction in energy for any given hammer because of variation across drivers. For impact hammers, the actual number of strikes at reduced energy will vary because operating the hammer at less than full power results in "bouncing" of the hammer as it strikes the pile, resulting in multiple "strikes"; however, as mentioned previously, South Fork Wind will target less than 20 percent of the total hammer energy for the initial hammer strikes during soft start. Soft start will be required at the beginning of each day's monopile installation, and at any time following a cessation of impact pile driving of 30 minutes or longer.

Shutdown of Impact Pile-driving

The purpose of a shutdown is to prevent some undesirable outcome, such as auditory injury or severe behavioral disturbance of sensitive species, by halting the activity. If a marine mammal is observed entering or within the respective shutdown zone (Table 24) after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving.

In situations when shutdown is called for but South Fork Wind determines shutdown is not practicable due to imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy must be implemented when the lead engineer determines it is practicable. After shutdown, impact pile driving may be reinitiated once all clearance zones are clear of marine mammals for the minimum species-specific periods, or, if required to maintain installation feasibility. Installation feasibility refers to ensuring that the pile installation results in a usable foundation for the WTG (*e.g.*, installed to the target penetration depth without refusal).

Visibility Requirements

Impact pile driving of monopiles must not be initiated at night, or when the full extent of the clearance zones (Table 24) cannot be confirmed to be clear of marine mammals, as determined by the lead PSO on duty. As mentioned previously, the 2.2 km clearance zone for non-NARW baleen whales may only be declared clear when the full extent of the minimum visibility zone is visible (*i.e.*, when not obscured by dark, rain, fog, etc.) and PSOs have not detected marine mammals for a full 30 minutes prior to impact pile driving. Impact pile driving of monopiles may continue after dark only when driving of the same pile began no less than 90 minutes prior to civil sunset, when the minimum visibility zone for impact pile driving of monopiles was fully visible, and must proceed for human safety or installation feasibility reasons. PSOs must utilize alternative technology (Infrared (IR) and/or Thermal camera) to monitor clearance zones if impact pile driving of monopiles continues past civil sunset.

Sound Attenuation

South Fork Wind must implement noise mitigation technology designed to result in the targeted reduction in sound levels that would produce measured ranges to Level A harassment and Level B harassment isopleths corresponding to those modeled assuming 10-dB sound attenuation, pending results of SFV (see *Acoustic Monitoring for Sound Field and Harassment Isopleth Verification* section below). The noise mitigation system must be either 1) a single BBC coupled with an additional noise mitigation device, or 2) a dBBC.

The bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 $m^3/(min*m)$, and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact. No parts of the ring or other objects should prevent full seafloor contact. South Fork Wind must require that

construction contractors train personnel in the proper balancing of airflow to the bubble ring, and must require that construction contractors submit an inspection/performance report for approval by South Fork Wind within 72 hours following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving. If South Fork Wind uses a noise mitigation device in addition to a BBC, similar quality control measures must be required.

Cofferdam Installation and Removal

Vibratory pile driving or impact driving of a casing pipe must occur at the export cable landing site only.

Visibility requirements

Vibratory pile driving of sheet piles may continue after dark only when the driving of the same pile began no less than 90 minutes prior to civil sunset, when the clearance zones were fully visible for a full 30 minutes immediately prior to commencing pile driving, and installation of sheet piles must proceed for human safety or installation feasibility reasons.

Clearance and Shutdown Zones

South Fork Wind must implement visual monitoring of the clearance zones for 30 minutes immediately prior to the initiation of ramp-up of vibratory piling equipment (Table 27). During this period, the clearance zone will be monitored by the PSOs, using the appropriate visual technology. Ramp-up may not be initiated if any marine mammal(s) is detected within its respective clearance zone. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (*i.e.*, 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

Table 27. Installation and Removal Of a Temporary Cofferdam: Radial Distances (m) to Level A Harassment and Level B Harassment Isopleths, Required Clearance and Shutdown Zones, and Vessel Separation Distances.

Species	Level A Harassment Zone (SEL)	Level B Harassment Zone (SPL)	Clearance Zone	Shutdown Zone	Vessel Separation Distance from Marine Mammals
Low-Frequency Cetaceans					
Fin whale	1,470	36,766	1,500	1,500	100
Minke whale	1,470	36,766	1,500	1,500	100
Sei whale	1,470	36,766	1,500	1,500	100
Humpback whale	1,470	36,766	1,500	1,500	100
North Atlantic right whale	1,470	36,766	1,500	1,500	500
Mid-Frequency Cetaceans					
Sperm whale	-	36,766	1,500	1,500	100
Atlantic spotted dolphin	-	36,766	100	50	50
Atlantic white-sided dolphin	-	36,766	100	50	50
Common dolphin	-	36,766	100	50	50
Risso's dolphin	-	36,766	100	50	50
Bottlenose dolphin	-	36,766	100	50	50
Long-finned pilot whale	-	36,766	100	50	50
High-Frequency Cetaceans					
Harbor porpoise	63	36,766	100	100	50
Phocid Pinnipeds in Water					
Gray seal	103	36,766	150	125	50
Harbor seal	103	36,766	150	125	50

SEL=cumulative sound exposure level in units of decibels referenced to 1 micropascal squared second; SPL=root-mean-square sound pressure level in units of decibels referenced to 1 micropascal.

Shutdown of Vibratory Pile Driving

An immediate shutdown of vibratory pile-driving equipment must be implemented if a marine mammal(s) is sighted entering or within its respective shutdown zone after cofferdam installation has commenced. Resumption of vibratory pile driving

may begin if the animal(s) has been observed exiting its respective shutdown zone or an additional time period has elapsed without a resighting *(i.e.*, 15 minutes for small odontocetes and seals and 30 minutes for all other species). If a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized number of takes has been met, approaches or is observed within the Level B harassment zone, vibratory pile-driving activities must be shut down immediately or delayed if vibratory pile driving has not commenced. Vibratory pile driving must not must not recommence until the animal(s) has been confirmed to have left the Level B harassment zone or a full 15 min (small odontocetes and seals) or 30 min (all other marine mammals) have elapsed with no further sightings.

Construction Surveys

Clearance and Shutdown Zones

South Fork Wind must implement a 30-minute clearance period of the clearance zones (Table 28) immediately prior to the initiation of ramp-up of boomers, sparkers, and Chirps. Since publication of the proposed IHA, the clearance zones for ESA-listed species have been increased from 100 to 500 m to align with standard marine site characterization mitigation and monitoring measures. Any large whale sighted by a PSO within 1,000 m of boomers, sparkers, and Chirps that cannot be identified to species must be treated as if it were a NARW. The clearance zones will be monitored by PSOs, using the appropriate visual technology. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up (described below) may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until an additional time period has elapsed with no further sighting (*i.e.*, 15 minutes for small odontocetes and seals, and 30 minutes for all other species). In cases when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (IR/thermal camera), and the lead PSO has determined that the clearance

zones are clear of marine mammals, survey operations may commence (*i.e.*, no delay is required) despite periods of inclement weather and/or loss of daylight. In cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations may continue (*i.e.*, no shutdown is required).

Table 28. Construction Surveys Operating Chirp Sub-Bottom Profilers, Boomers, and Sparkers: Radial Distances (m) to Level A Harassment and Level B Harassment Isopleths, Required Clearance and Shutdown Zones, and Vessel Separation Distances.

Species	Level A Harassment Zone (SEL)	Level A Harassment Zone (PK)	Maximum Extent of Zones				Vessel Separation Distance from Marine Mammals
			Level B Harassment Zones		Clearance Zone	Shutdown Zone	
			Chirps	Boomers and Sparkers			
Low-Frequency Cetaceans							
Fin whale	< 1	< 1	54	141	500	100	100
Minke whale	< 1	< 1	54	141	100	100	100
Sei whale	< 1	< 1	54	141	500	100	100
Humpback whale	< 1	< 1	54	141	100	100	100
North Atlantic right whale	< 1	< 1	54	141	500	500	500
Mid-Frequency Cetaceans							
Sperm whale	< 1	< 1	54	141	500	100	100
Atlantic spotted dolphin	< 1	< 1	54	141	100	-	50
Atlantic white-sided dolphin	< 1	< 1	54	141	100	-	50
Common dolphin	< 1	< 1	54	141	100	-	50
Risso's dolphin	< 1	< 1	54	141	100	-	50
Bottlenose dolphin	< 1	< 1	54	141	100	-	50
Long-finned pilot whale	< 1	< 1	54	141	100	-	50
High-Frequency Cetaceans							
Harbor porpoise	37	5	54	141	100	100	50

Phocid Pinnipeds in Water							
Gray seal	< 1	< 1	54	141	100	-	50
Harbor seal	< 1	< 1	54	141	100	-	50

Ramp-Up of HRG Survey Equipment

At the start or restart of the use of boomers, sparkers, and/or Chirps, a ramp-up procedure must be implemented. Ramp-up must begin with the powering up of the specified HRG equipment at the lowest power output appropriate for the survey. When practicable, the power must then be gradually turned up, and then any other acoustic sources added. The ramp-up procedure must be used at the beginning of construction survey activities using the specified HRG equipment to provide additional protection to marine mammals in or near the survey area by allowing them to vacate the area prior to operation of survey equipment at full power.

Ramp-up activities will be delayed if a marine mammal(s) enters its respective clearance zone. Ramp-up will continue if the animal(s) has been observed exiting its respective clearance zone or until additional time has elapsed with no further sighting (*i.e*, 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

Shutdown of Construction Survey Equipment

An immediate shutdown of boomers and sparkers is required if a marine mammal(s) is sighted entering or within its respective shutdown zone. No shutdown is required for Chirp sub-bottom profilers. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement between the Lead PSO and vessel operator should be discussed only after shutdown has occurred. Subsequent restart of the survey equipment may be initiated if the animal(s) has been observed exiting its respective shutdown zone or until an additional period has elapsed *(i.e.*, 15 minutes for small odontocetes and seals and 30 minutes for all other marine mammals).

If a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized number of takes has been met, approaches or is observed within the Level B harassment zone, boomers and sparkers must be shut down immediately, or use delayed if not yet activated. Use of boomers and sparkers must not must not commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or a full 15 minutes (small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sightings.

If a boomer, sparker, or Chirp is shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective shutdown zones. If a boomer, sparker, or Chirp is shut down for a period longer than 30 minutes, then clearance and ramp-up procedures must be initiated as described in the previous section.

The shutdown requirement will be waived for small delphinids of the following genera: *Delphinus, Stenella,* and *Tursiops*. Specifically, if a delphinid from the specified genera is visually detected approaching the vessel (*i.e.*, to bow ride) or towed equipment, shutdown is not required. Furthermore, if there is uncertainty regarding identification of a marine mammal species (*i.e.*, whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), PSOs must use their best professional judgement in making the decision to call for a shutdown. Additionally, shutdown is required if a delphinid that belongs to a genus other than those specified is detected in the shutdown zone.

Vessel Strike Avoidance

The IHA contains numerous vessel strike avoidance measures. South Fork Wind is required to comply with these measures except under circumstances when doing so

would create an imminent and serious threat to a person or vessel, or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply.

South Fork Wind must submit a NARW vessel strike avoidance plan 90 days prior to commencement of vessel use. The plan will describe, at a minimum, how PAM will be conducted to ensure the transit corridor is clear of NARWs. The plan must also provide details on the vessel-based observer protocols on transiting vessels. The requirement to submit this plan was not included in the proposed IHA.

Vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course as appropriate and regardless of vessel size, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (distances stated below). Visual observers monitoring the vessel strike avoidance zone may be third-party observers (*i.e.*, PSOs) or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena and broadly to identify a marine mammal as a NARW, other whale (defined in this context as sperm whales or baleen whales other than NARWs), or other marine mammal. South Fork Wind must adhere to the following measures:

- Year-round, operators of all vessels associated with South Fork Wind must use all available sources of information on NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and Coast Guard VHF Channel 16 throughout the day to receive notifications of any sightings and/or information associated with any Slow Zones (*i.e.*, DMAs or acoustically-triggered slow zones) to plan vessel routes, if practicable, to minimize the potential for co-occurrence with any NARWs.
- For construction surveys, members of the PSO monitoring team must consult

the Right Whale Sightings Advisory System, WhaleAlert app, and monitor Coast Guard VHF Channel 16 for reports of NARW presence in the survey area.

- On all vessels associated with South Fork Wind, regardless of size or speed of travel, operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course as appropriate to avoid striking any marine mammal.
- Whenever multiple project-associated vessels (*e.g.*, construction survey, crew transfer) are operating concurrently, any visual observations of ESA-listed marine mammals must be communicated to PSOs and/or vessel captains associated with other vessels to increase situational awareness.
- Vessels of all sizes associated with South Fork Wind must operate port to port at 10 kts or less between November 1 and April 30, and while operating in the Lease Area, along the SFEC, or transit area to and from ports in NY, CT, RI, and MA, except for vessels transiting inside Narragansett Bay or Long Island Sound (unless during a DMA). Vessels transiting from other ports outside those described must operate at 10 kts or less when within any active Seasonal Management Area (SMA) or within the Lease Area.
- For vessels of all sizes, vessel speeds must immediately be reduced to 10 kts when any large whale, mother/calf pairs, or large assemblages of non-delphinoid cetaceans are observed near (within 100 m) an underway vessel. In the proposed IHA, this measure only applied to vessels greater than or equal to 65 ft (19.8 m).

The measures above were not included in the proposed IHA, but are included in the final IHA. The measures below were included in the proposed IHA and are carried over to the final IHA.

- All vessels 65-ft (19.8 m) or greater in length must comply with the 10-kt speed restriction rule in any SMA, per the NOAA ship strike reduction rule (74 FR 60173; October 10, 2008).
- All underway vessels (*e.g.*, transiting, surveying) must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard). Visual observers must be equipped with alternative monitoring technology for periods of low visibility (*e.g.*, darkness, rain, fog, etc.). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this IHA. Visual observers may be third-party observers (*i.e.*, NMFS-approved PSOs) or crew members. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities. Confirmation of the observers' training and understanding of the IHA requirements must be documented on a training course log sheet and reported to NMFS.
- Vessel speed must immediately be reduced to 10 kts or less when a NARW is sighted by an observer or anyone else on the underway vessel.
- In the event that any Slow Zone (designated as a DMA) is established that overlaps with an area where a project-associated vessel must operate, that vessel, regardless of size, must transit that area at 10 kts or less.
- If a vessel is traveling at greater than 10 kts between May 1 and October 31, in addition to the required dedicated observer, real-time PAM of transit corridors must be conducted prior to and during transits. If a NARW is detected via visual observation or PAM within or approaching the transit

corridor, all crew transfer vessels must travel at 10 kts or less for the following 12 hours. Each subsequent detection will trigger a 12-hour reset. A slow-down in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 12 hours.

- All vessels must maintain a minimum separation distance of 500 m from NARWs. If a whale is observed but cannot be confirmed as a species other than a NARW, the vessel operator must assume that it is a NARW and take appropriate action.
- If underway, all vessels must steer a course away from any sighted NARW at 10 kts or less such that the 500-m minimum separation distance requirement is not violated. If a NARW, or a large whale that cannot be confirmed to species, is sighted within 500 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 500 m.
- All vessels must maintain a minimum separation distance of 100 m from sperm whales and non-NARW baleen whales. If one of these species is sighted within 100 m of an underway vessel, that vessel must shift the engine to neutral. Engines will not be engaged until the whale has moved outside of the vessel's path and beyond 100 m.
- All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.*, bow-riding dolphins). If a delphinoid cetacean or pinniped is sighted within 50 m of an underway vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.*, bow-riding dolphins). Engines will not be engaged until the animal(s) has moved outside of the

vessel's path and beyond 50 m.

- When a marine mammal(s) is sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.*, attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engine(s) until the animal(s) is clear of the area. This does not apply to any vessel towing gear or any vessel that is navigationally constrained
- All vessels underway must not divert or alter course in order to approach any marine mammal. Any vessel underway must avoid excessive speed or abrupt changes in direction.
- For in-water construction heavy machinery activities other than impact or vibratory pile driving, if a marine mammal comes within 10 m of equipment, South Fork Wind must cease operations (when practicable) until the marine mammal has moved more than 10 m on a path away from the activity.

With the measures described herein, NMFS has prescribed the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the

necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the planned action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas).
- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors.
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

Visual Marine Mammal Observations

South Fork Wind must collect sighting data and behavioral responses to construction activities for marine mammals species observed in the region of activity

during the period of activity. All observers must be trained in marine mammal identification and behaviors and are required to have no other construction-related tasks while conducting monitoring. PSOs will monitor all clearance and shutdown zones prior to, during, and following impact and vibratory pile driving, and while boomers, sparkers, and Chirps are active. PSOs will also monitor Level B harassment zones and will document any marine mammals observed within these zones, to the extent practicable (noting that some zones are too large to fully observe). As mentioned, South Fork Wind must conduct monitoring before, during, and after construction activities (monitoring durations specified below), with observers located at the best practicable vantage points on the pile driving and dedicated PSO vessels. Full details regarding marine mammal monitoring must be included in a Pile Driving and Marine Mammal Monitoring Plan that, under the IHA, South Fork Wind is required to submit to NMFS for approval at least 90 days in advance of commencement of construction activities. Please note submission of this plan was not included in the proposed IHA. The following additional measures apply to visual monitoring:

(1) Monitoring must be conducted by qualified, trained PSOs who will be placed on the pile-driving and dedicated PSO vessels (monopile), installation or nearby construction vessel (cofferdam or casing pipe), and construction survey vessels, in positions which represent the best vantage point to monitor for marine mammals and implement shutdown procedures when applicable;

(2) PSOs may not exceed 4 consecutive watch hours; must have a minimum 2-hour break between watches; and may not exceed a combined watch schedule of more than 12 hours in a 24-hour period;

(3) PSOs must have no other construction-related tasks while conducting monitoring;

(4) PSOs should have the following minimum qualifications:

- Visual acuity in both eyes (correction is permissible) sufficient for discernment of moving targets at the water's surface with ability to estimate target size and distance; use of binoculars may be necessary to correctly identify the target;
- Ability to conduct field observations and collect data according to assigned protocols;
- Sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations;
- Writing skills sufficient to document observations including, but not limited to: the number and species of marine mammals observed; dates and times when in-water construction activities were conducted; dates and times when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone; and marine mammal behavior; and
- Ability to communicate orally, by radio or in person, with project personnel to provide real-time information on marine mammals observed in the area as necessary.

Observer teams employed by South Fork Wind in satisfaction of the mitigation and monitoring requirements described herein must meet the following additional requirements:

- Independent observers (*i.e.*, not construction personnel) are required;
- At least one observer must have prior experience working as an observer;
- Other observers may substitute education (degree in biological science or related field) or training for experience;

- One observer will be designated as lead observer or monitoring coordinator. The lead observer must have prior experience working as an observer; and
- All PSOs must be approved by NMFS. South Fork Wind must submit the CVs of the initial set of PSOs necessary to commence the project to NMFS OPR for approval at least 60 days prior to the first day of construction activities.

South Fork Wind must conduct briefings between construction supervisors and crews and the PSO team prior to the start of all construction activities, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocols, and operational procedures. An informal guide must be included with the Marine Mammal Monitoring Plan to aid in identifying species if they are observed in the vicinity of the project area.

The following are measures specific to each activity.

Monopile Installation

South Fork Wind must implement the following procedures for impact pile driving of monopiles:

- A minimum of two PSOs on the impact pile-driving vessel must maintain watch at all times when impact pile driving is underway.
- A minimum of two PSOs on a dedicated PSO vessel located at the outer edge of the 2,200 m (or as modified based on SFV) large whale clearance zone must maintain watch at all times when impact pile driving of monopiles is underway.
- PSOs must be located at the best vantage point(s) on the impact pile-driving vessel and dedicated PSO vessels in order to ensure 360° visual coverage

of the entire clearance and shutdown zones around the vessels, and as much of the Level B harassment zone as possible.

- The clearance zones must be monitored for the presence of marine mammals for 60 minutes before, throughout the installation of the monopile, and for 30 minutes after monopile installation.
- During all observation periods, PSOs must use high magnification (25X) binoculars, standard handheld (7X) binoculars, and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.*, darkness, rain, fog, etc.), PSOs must use alternative technology (*e.g.*, IR/Thermal camera) to monitor clearance and shutdown zones.
- Monopile installation may only commence when the minimum visibility zone (2.2 km) is fully visible (*e.g.*, not obscured by darkness, rain, fog, etc.) and clearance zones are clear of marine mammals for at least 30 minutes, as determined by the lead PSO, immediately prior to initiation of impact pile driving of monopiles.
- If the minimum visibility zone (2.2 km) is obscured by fog or poor lighting conditions while impact pile driving of monopiles is underway, the activity must be halted when practicable, as described above. Following a shutdown, monopile installation may not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes, as described above.

During vessel transits within or to/from the SFWF (*e.g.*, crew transfer, etc.), an observer must be stationed on vessels at the best vantage points to ensure maintenance of standoff distances between marine mammals and vessels (as described above). South Fork Wind must implement the following measures during vessel transit when there is an observation of a marine mammal:

- PSOs or dedicated observers will record the time, date, vessel's position, heading and speed, sea state, water depth, and visibility, marine mammal species identification, initial distance and bearing from the vessel to the marine mammal, closest point of approach, and any avoidance measures taken in response to the marine mammal sighting. Individuals implementing the monitoring protocol will assess its effectiveness using an adaptive approach. PSOs will use their best professional judgment throughout implementation and seek improvements to these methods when deemed appropriate. Any modifications to the protocol will be coordinated between NMFS and South Fork Wind.

Cofferdam or casing pipe installation and removal

South Fork Wind must implement the following procedures for impact and vibratory pile driving associated with installation of a cofferdam or casing pipe:

- A minimum of two PSOs will maintain watch at all times when vibratory pile driving or impact hammering is underway.
    - PSOs must be located at the best vantage point(s) on the impact or vibratory pile-driving platform, or platform in the immediate vicinity of the impact or vibratory pile-driving platform, in order to ensure visual coverage of the entire visual clearance zones and as much of the Level B harassment zone as possible.
- The clearance zones will be monitored for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles (and casing pipe, if installed), and for 30 minutes after all vibratory pile-driving or impact-hammering activity.
- During all observation periods related to impact and vibratory pile driving, PSOs must use high-magnification (25X), standard handheld (7X) binoculars, and the naked eye to search continuously for marine mammals.

During periods of low visibility (*e.g.*, darkness, rain, fog, etc.), PSOs must use alternative technology (*e.g.*, IR/Thermal camera) to monitor clearance and shutdown zones.

- Sheet pile or casing pipe installation may only commence when visual clearance zones are fully visible (*e.g.*, not obscured by darkness, rain, fog, etc.) and clear of marine mammals, as determined by the lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving.

Construction Surveys

South Fork Wind must implement the following procedures for construction surveys:

- At least one PSO must be on duty on each survey vessel during daytime operations, conducting visual observations at all times during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset).
- A minimum of two PSOs must be on watch during nighttime operations.
- The clearance zones must be monitored for the presence of marine mammals for 30 minutes before, throughout, and for 30 minutes after use of boomers, sparkers, and Chirps.
- During all observation periods, PSOs must use standard handheld (7X) binoculars and the naked eye to search continuously for marine mammals. During periods of low visibility (*e.g.*, darkness, rain, fog, etc.), PSOs must use alternative technology (*e.g.*, IR/Thermal camera) to monitor clearance and shutdown zones.
- Ramp-up of boomers, sparkers, and Chirps may only commence when visual clearance zones are fully visible (*e.g.*, not obscured by darkness,

rain, fog, etc.) and clear of marine mammals, as determined by the lead PSO, for at least 30 minutes immediately prior to initiation of survey activities utilizing the specified acoustic sources.

- In cases where multiple vessels are surveying concurrently, any observations of marine mammals must be communicated to PSOs on all nearby survey vessels.
- During daylight hours when survey equipment is not operating, South Fork Wind must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports.

Data Collection

NMFS requires that observers use standardized forms. In addition to other data, South Fork Wind must record detailed information about any implementation of delays or shutdowns, including the distance of the animal(s) to the pile or specified HRG equipment and a description of specific actions that ensued and resulting behavior of the animal, if any. NMFS requires that, at a minimum, the following information be collected on the sighting forms:

- Date and time that monitored activity begins or ends;
- Construction activities occurring during each observation period;
- Weather parameters (*e.g.*, wind speed, percent cloud cover, visibility);
- Water conditions (*e.g.*, sea state, tide state);
- All marine mammal sightings, regardless of distance from the construction activity;
- Species, numbers, and, if possible, sex and age class of marine mammals;

- Description of any marine mammal behavioral observations (*e.g.*, observed behaviors such as feeding or traveling), including an assessment of behavioral responses thought to have resulted from the activity;
- Distance and bearing of each marine mammal observed relative to the pile being driven or specified HRG equipment for each sighting, and time spent within harassment zones;
- Type of construction activity (*e.g.*, vibratory or impact pile driving, construction survey) and specific phase of activity (*e.g.*, ramp-up of HRG equipment, HRG acoustic source on/off, soft start for impact pile driving, active pile driving, etc.) when marine mammals are observed.
- Description of implementation of mitigation measures (*e.g.*, delay or shutdown).
- Locations of all marine mammal observations; and
- Other human activity in the area.

Marine Mammal Passive Acoustic Monitoring

South Fork Wind must utilize a PAM system to supplement visual monitoring for all monopile installations. The PAM system must be monitored by a minimum of one PAM PSO beginning at least 60 minutes prior to soft start of impact pile driving of monopiles, at all times during monopile installation, and 30 minutes post-completion of installation. PAM PSOs must immediately communicate all detections of marine mammals at any distance (*i.e.,* not limited to the 5-km Level B harassment zone) to visual PSOs, including any determination regarding species identification, distance, and bearing and the degree of confidence in the determination.

PAM PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches. PAM PSOs must be required to demonstrate that they have completed specialized training for operating PAM systems,

including identification of species-specific mysticete vocalizations. PSOs can act as PAM PSOs or visual PSOs (but not simultaneously) as long as they demonstrate that their training and experience are sufficient to perform each task.

A Passive Acoustic Monitoring Plan must be submitted to NMFS and BOEM for review and approval at least 90 days prior to the planned start of monopile installations. PAM must follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.*, 2021). The plan must describe all proposed PAM equipment, procedures, and protocols. Please see the IHA for additional PAM requirements.

Acoustic Monitoring for Sound Field and Harassment Isopleth Verification

During the first three monopile installations, South Fork Wind must empirically determine the ranges to the isopleths corresponding to Level A harassment and Level B harassment thresholds. For verification of the range to the Level B harassment isopleth, South Fork Wind must report the measured or extrapolated ranges where the received levels SPL_{rms} decay to 160 dB, as well as integration time for such SPL_{rms}. South Fork Wind may also estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from *in situ* measurements conducted at several distances from the pile being driven. In addition, South Fork Wind must measure received levels at a standard distance of 750 m from the pile, or an alternative distance as agreed to in the SFV Plan.

If acoustic field measurements for installation of the first monopile indicate ranges to the isopleths corresponding to Level A harassment and Level B harassment isopleths are greater than the ranges predicted by modeling (assuming 10-dB attenuation), South Fork Wind must implement additional noise mitigation measures prior to installing the second monopile. Initial additional measures may include improving the efficacy of the implemented noise mitigation technology (*e.g.,* BBC, dBBC) and/or modifying the

piling schedule to reduce the sound source. Each sequential modification must be evaluated empirically by acoustic field measurements. In the event that field measurements indicate ranges to isopleths corresponding to Level A harassment and Level B harassment thresholds are consistently greater than the ranges predicted by modeling (assuming 10-dB attenuation), NMFS may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols. If harassment zones are expanded beyond an additional 1,500 m, additional PSOs must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180° and of an area with a radius no greater than 1,500 m. Depending on the extent of zone size expansion, reinitiation of consultation under Section 7 of the ESA may be required.

If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10-dB attenuation), South Fork Wind may request a modification of the clearance and shutdown zones for impact pile driving of monopiles. For a modification request to be considered by NMFS, South Fork Wind must have conducted SFV on three or more monopile installations to verify that zone sizes are consistently smaller than predicted by modeling (assuming 10-dB attenuation). In addition, if a subsequent monopile installation location is selected that was not represented by previous three locations (*i.e.*, substrate composition, water depth), SFV must be conducted. Upon receipt of an interim SFV report, NMFS may adjust zones (*i.e.*, Level A harassment, Level B harassment, clearance, and/or shutdown) to reflect SFV measurements. The shutdown and clearance zones would be equivalent to the measured range to the Level A harassment isopleths plus 10 percent (shutdown zone) and 20 percent (clearance zone), rounded up to the nearest 100 m for PSO clarity. However, the minimum visibility zone must not be decreased to a radius smaller than 2.2 km from the pile. The shutdown zone

for sei, fin, and sperm whales must not be reduced to a size less than 1,000 m. The visual and PAM clearance and shutdown zones for NARWs must not be decreased, regardless of acoustic field measurements. The Level B harassment zone would be equal to the largest measured range to the Level B harassment isopleth.

Reporting

A draft final report must be submitted to NMFS within 90 days of the completion of activities occurring under this IHA. The report must include marine mammal observations pre-activity, during-activity, and post-activity for all pile-driving and construction survey days, and must also provide descriptions of any changes in marine mammal behavioral patterns resulting from construction activities. The report must detail the implemented monitoring protocol, summarize the data recorded during monitoring including an estimate of the number of marine mammals that may have been harassed during the period of the report, and describe any mitigation actions taken (*i.e.*, delays or shutdowns due to detections of marine mammals, documentation of when shutdowns were called for but not implemented and why). The report must also include results from acoustic monitoring including, but not limited to, dates and times of all detections, types and nature of sounds heard, whether detections were linked with visual sightings, water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), spectrogram screenshot, a record of the PAM PSO's review of any acoustic detections, and any other notable information. A final report must be submitted within 30 days following resolution of comments on the draft report.

South Fork Wind will be required to provide the initial results of SFV (including measurements) to NMFS in interim reports after each monopile installation for the first three piles as soon as they are available, but no later than 48 hours after each installation. If SFV is required for subsequent monopile installations, the same reporting timeline and

data requirements apply. In addition to *in situ* measured ranges to the Level A harassment and Level B harassment isopleths, the acoustic monitoring report must include: SPL_{peak}, SPL_{rms} that contains 90 percent of the acoustic energy, single strike sound exposure level, integration time for SPL_{rms}, SEL_{ss}, and 24-hour cumulative SEL extrapolated from measurements. All these levels must be reported in the form of median, mean, max, and minimum. The acoustic monitoring report must also include a description of the hydrophones used, hydrophone and water depth, distance to the pile driven, and sediment type at the recording location. Final results of SFV must be submitted as soon as possible, but no later than within 90 days following completion of impact pile driving of monopiles. Please see the IHA for a full list of reporting requirements.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. NMFS also assesses the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*,

as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

Impact and vibratory pile-driving and construction survey activities associated with South Fork Wind's project, as described previously, have the potential to disturb or temporarily displace marine mammals. Specifically, the specified activities may result in take, in the form of Level A harassment (PTS, from impact pile driving only) or Level B harassment (potential behavioral disturbance) from underwater sounds generated by pile driving (impact and vibratory) and certain HRG active acoustic sources used for construction surveys. Potential take could occur if individual marine mammals are present in the ensonified zone when any pile-driving or construction survey activities are occurring.

To avoid repetition, the majority of our analyses apply to all the species listed in Table 3, given that many of the anticipated effects of South Fork Wind's project on different marine mammal stocks are expected to be relatively similar in nature. Where there are meaningful differences between species or stocks—as is the case of the NARW—they are included as separate subsections below.

Non-NARW marine mammal species

Impact pile driving has source characteristics (short, sharp pulses with higher peak levels and sharper rise time to reach those peaks) that are potentially injurious or more likely to produce severe behavioral reactions. However, modeling indicates there is limited potential for injury (*i.e.*, PTS), even in the absence of the mitigation measures (Table 16). The potential for injury is expected to be greatly minimized through implementation of mitigation measures including soft start, use of a noise mitigation system, and the implementation of clearance zones that would facilitate a delay of impact pile driving of monopiles if marine mammals were observed (visually and/or acoustically) approaching or within areas that could be ensonified above sound levels that

could result in auditory injury. Given sufficient notice through use of soft start, marine mammals are expected to move away from a sound source that is annoying prior to it becoming potentially injurious (*i.e.*, PTS) or resulting in more severe behavioral reactions. The requirement that the clearance process for impact and vibratory pile driving may only commence when the full extents of the respective visual clearance zones are entirely visible to PSOs will facilitate a high rate of success in marine mammal detection and implementation of mitigation measures (*i.e.*, delay) to avoid injury.

NMFS expects that any take resulting from exposures above the Level A harassment threshold would be in the form of slight PTS (minor degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by impact pile driving (*i.e.* the low-frequency region below 2 kHz)), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which in most cases is not likely to meaningfully affect its ability to forage and communicate with conspecifics, much less impact reproduction or survival.

Additionally, the amount of authorized take, by Level A harassment, is very low for all marine mammal stocks and species. For 11 of 15 stocks, NMFS authorizes no Level A harassment take over the duration of South Fork Wind's planned activities; for the other four stocks, NMFS authorizes no more than 4 takes by Level A harassment. As described above, NMFS expects that marine mammals would likely move away from an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice through use of soft start, thereby minimizing the degree of PTS that would be incurred. Even absent mitigation, no serious injury or mortality from construction activities is anticipated or authorized.

NMFS has authorized an amount of Level B harassment take for all marine mammal species based on either modeling or information reflected in field data (*e.g.*,

monitoring reports, published group sizes); NMFS based the number of authorized takes on whichever approach resulted in a greater amount. This authorized take, by Level B harassment, reflects behavioral disturbance directly in response to noise exposure (*e.g.*, avoidance) or indirectly from associated impacts such as TTS or masking. Both the amount and intensity of Level B harassment will be reduced to the level of least practicable adverse impact through use of required mitigation measures. Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as avoidance, increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring) (*e.g.*, Thorson and Reyff, 2006; HDR, Inc., 2012; Lerma, 2014). Most likely, individuals will simply move away from the sound source and temporarily avoid the area where impact or vibratory pile driving is occurring. Therefore, NMFS expects that animals annoyed by project sound would simply avoid the area during impact or vibratory pile driving in favor of other, similar habitats. NMFS expects that any avoidance of the project area by marine mammals would be temporary in nature and that any marine mammals that avoid the project area during construction would not be permanently displaced.

Feeding behavior is not likely to be significantly impacted, as most prey species are mobile, broadly distributed throughout the project area, and likely to only respond temporarily to exposure to impact or vibratory pile-driving noise; therefore, marine mammals that may be temporarily displaced during construction activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Soft starts would allow mobile prey to move away from the source prior to exposure to any noise levels that may cause physical injury. The use of noise mitigation devices during impact pile driving of monopiles should reduce sound levels to the degree that any mortality or injury of prey will minimized. Use of bubble curtains, for

example, is a key mitigation measure in reducing injury and mortality of ESA-listed salmon on the west coast during impact pile driving. NMFS recognizes some mortality, physical injury and/or hearing impairment in marine mammal prey may still occur but anticipates the amount of prey impacted in this manner is minimal compared to overall prey availability. Any behavioral responses by mobile marine mammal prey are expected to be brief. For example, Jones *et al.* (2020) found that when squid (*Doryteuthis pealeii*) were exposed to impact pile-driving noise, body pattern changes, inking, jetting, and startle responses were observed and nearly all squid exhibited at least one response. However, these responses occurred primarily during the first eight impulses and diminished quickly, indicating potential rapid, short-term habituation. NMFS expects that other impacts such as stress or masking would occur in fish that serve as marine mammal prey (Thomas *et al.* 2006); however, those impacts would be limited to the duration of impact or vibratory pile driving and, if prey were to move out the area in response to noise, these impacts would be minimized.

Because of the temporary nature of the disturbance and the availability of similar habitat and resources in the surrounding area, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. There are no notable areas of biological significance for non-NARW marine mammals, other than fin whales, known to exist within the Lease Area or potential export cable route corridors. Although the SFWF and SFEC will be constructed within a fin whale foraging BIA that exists east of Montauk Point, NY, from March through October, the BIA is considerably larger than the relatively small area within which impacts from monopile installations may occur; this difference in scale will provide ample access to foraging opportunities for fin whales within the remaining area of the BIA. Vibratory pile-driving for installation of the cofferdam will occur sometime between November 2022 and April 2023 (removal could

occur any time prior to expiration of this IHA); this schedule indicates that the overlap between cofferdam installation and the fin whale foraging BIA would occur for only 36 non-continuous hours. Monopiles will be installed on up to 16 days, which is a small percentage of the duration of the fin whale foraging BIA. Impact pile driving of one monopile per day (the limit under the IHA), and the associated potential disturbance of foraging fin whales, will only occur for 2-4 hours per day. The remaining 20-22 hours of the day will provide fin whales the opportunity to forage undisturbed by noise produced during monopile installation. Any disruption of feeding behavior or avoidance of the project area by fin whales is expected to be temporary, with habitat utilization by fin whales returning to baseline once the disturbance ceases. In addition, a second, larger, year-round fin whale foraging BIA, as well as foraging BIAs for sei, humpback, and minke whales, are delineated to the east of the project area. This second fin whale BIA will provide alternate suitable habitat and food resources for foraging fin whales during construction activities within the SFWF and SFEC. Please see LeBrecque *et al.* (2015) for maps of all East Coast BIAs. It is extremely unlikely that feeding (or non-feeding) whales would be able to detect any impact or vibratory pile-driving noise, even near the western-most edges of the BIAs, given the absorption of sound over the large propagation distances between the Lease Area and the BIAs. Finally, there are no rookeries, mating, or calving areas known to be biologically important to marine mammals within the project area.

Repeated exposures of individuals to relatively low levels of sound outside of preferred habitat areas are unlikely to significantly disrupt critical behaviors. Thus, even repeated Level B harassment of some small subset of an overall stock is unlikely to result in any significant realized decrease in viability for the affected individuals, and thus would not result in any adverse impact to the stock as a whole.

NMFS concludes that exposures to marine mammals due to South Fork Wind's activity would result in only short-term effects to individuals exposed. Marine mammals may temporarily avoid the immediate area but are not expected to permanently abandon the area. Impacts to breeding, feeding, sheltering, resting, or migration are not expected, nor are shifts in habitat use, distribution, or foraging success. NMFS does not anticipate the marine mammal takes that would result from the planned activity would impact annual rates of recruitment or survival.

As described in the notice of the proposed IHA (86 FR 8490; February 5, 2021), humpback and minke whales, and gray and harbor seals are experiencing ongoing UMEs. For minke whales and seals, although the ongoing UME is under investigation (as occurs for all UMEs), this event does not provide cause for concern regarding population-level impacts. The minke whale population abundance is greater than 20,000 whales. Even though the PBR value is based on an abundance for U.S. waters that is negatively biased and a small fraction of the true population abundance, annual M/SI does not exceed the calculated PBR value for minke whales. For harbor seals, the population abundance is over 75,000 and annual M/SI (345) is well below PBR (2,006) (Hayes *et al.*, 2018). For gray seals, the population abundance is over 27,000, and abundance is likely increasing in the U.S. Atlantic EEZ and in Canada (Hayes *et al.*, 2018). For harp seals, the current population trend in U.S. waters is unknown, as is PBR (Hayes *et al.*, 2018); however, the population abundance is over 7 million seals, suggesting that the UME is unlikely to result in population-level impacts (Hayes *et al.*, 2018). With regard to humpback whales, the population is facing a UME wherein elevated strandings have occurred since 2016 and are ongoing. A portion of the whales have shown evidence of pre-mortem vessel strike; however, this finding is not consistent across all whales examined and investigations are ongoing. Animals involved in this UME primarily belong to the West Indies Distinct Population Segment (DPS), of which the Gulf of Maine stock is a part.

While the MMPA designated Gulf of Maine stock is relatively small (n=1,393), the most recent population estimate for the ESA-designated West Indies DPS (of which animals belonging to the Gulf of Maine stock also belong) is approximately 10,400 animals (Smith *et al*, 2009). The UME is a cause for concern to the Gulf of Maine stock; however, the taking associated with the issuance of the IHA is not anticipated to contribute to the UME or impact the stock such that it would affect annual rates or recruitment or survival. Authorized take numbers, by Level A harassment, for the potentially impacted species are very low (*i.e.*, no more than 4 takes by Level A harassment authorized for any of these species) and as described above, any Level A harassment would be expected to be in the form of slight PTS (*i.e.* minor degradation of hearing capabilities) which is not likely to meaningfully affect the ability to forage or communicate with conspecifics. The suite of measures for vessel operation and monitoring ensure risk of serious injury or mortality from ship strikes is minimized such that the probability of a strike is *de minimus*. Mortality and serious injury is neither expected, even absent mitigation, nor authorized, and Level B harassment of humpback whales and minke whales and gray, harbor, and harp seals will be reduced to the level of least practicable adverse impact through implementation of mitigation measures. As such, the authorized take of these species would not exacerbate or compound the ongoing UMEs in any way.

North Atlantic Right Whales

NARWs are currently threatened by low population abundance, higher than average mortality rates, and lower than average reproductive rates. Pace *et al.* (2021) recently released an update of his NARW abundance model. From 1990-2014, the female apparent survival rate fluctuated around 0.96. In 2014, survival decreased to approximately 0.93 and hit an all-time low of 0.89 in 2017. However, in 2018, survival increased dramatically back to around 0.95. The average survival rate, based on the Pace

et al. (2021) regime model from 2014-2018, is approximately 0.93, slightly lower than the average long-term rate from 1990-2014 (0.96). Since 1990, the estimated number of new entrants (which can be used as a proxy for recruitment rates) has widely fluctuated between 0 and 39 (Pace *et al.*, 2021, NMFS 2021). In the last 10 years (2011-2020), the average number of calves born into the population is approximately 11. Unfortunately, not all calves born into the population survive. For example, on December 22, 2020, a newborn calf was sighted off El Hierro, an island in the Canary Islands, but has not been subsequently detected with its mother, suggesting it did not survive. More recently, a dead NARW calf was reported stranded on February 13, 2021, along the Florida coast.

On November 24, 2021, a NARW and newborn calf were sighted east of Pawleys Island, SC. On December 2, 2021, a second NARW and newborn calf were sighted east of the northern tip of Cumberland Island, GA; the NARW in this pair is currently entangled. On December 10, 2021, a third NARW and newborn calf were sighted off Ossabaw Island, GA, and a fourth pair was sighted off Morris Island, SC, on the same day. The fifth and sixth NARW/calf pairs were sighted off Fernandina Beach, FL, and near Nassau Sound, FL, respectively, on December 16, 2021. On December 18, 2021, a seventh NARW and calf were sighted off Amelia Island, FL, and an eighth NARW/calf pair was sighted in Florida off the St. Johns River entrance. A ninth NARW/calf pair was sighted off St. Simons Sound, GA, on December 26, 2021. The most recent information on the status of NARWs can be found in NMFS' 2021 Draft Stock Assessment Reports, available online at: (*www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*).

As described above, the project area represents part of an important migratory area for NARWs. In addition, core year-round foraging habitats have been identified south of Martha's Vineyard and Nantucket to the east of the project area (Oleson *et al.*, 2020); however, abundance in this area in summer months remains low compared to

winter. It also appears the majority of sightings from June through October (when South Fork Wind would be conducting most, if not all, monopile installations) are concentrated approximately 90 km east of the Lease Area, on Nantucket Shoals (sightings which triggered DMAs in 2019, 2020, and 2021) with occasional sightings or acoustic detections within the project area triggering DMAs or acoustic Slow Zones. In general, due to the current status of NARWs, and the spatial overlap of the planned project with an area of biological significance for NARWs, the potential impacts of the planned project on NARWs warrant particular attention.

The IHA includes the following nine overarching mitigation measures related to impact pile driving of monopiles, which are intended to reduce both the number and intensity of NARW takes: (1) time of year restrictions; (2) time of day restrictions; (3) implementation of clearance zones; (4) implementation of shutdown zones; (5) use of soft-start; (6) use of noise mitigation technology; (7) use of PSOs to visually observe for NARWs (with any detection within designated zones triggering delay or shutdown); (8) use of PAM to acoustically detect NARWs (with any detection within designated zones triggering delay or shutdown); and (9) enhanced awareness of NARW presence (*e.g.*, requirement to monitor NARW sighting network platforms to be aware of NARW presence within or near the project area and/or transit corridors). The specifics regarding these measures are dependent upon the time of year. In addition, the IHA includes mitigation measures for cofferdam installation (and removal) which mirror a subset of those prescribed for monopile installation (measures (2-5), (7) and (9)). There is no time of year restriction on vibratory pile driving at the HDD site; however, installation and removal will only require a maximum of 36 hours (18 hours for installation, 18 hours for removal). Finally, mitigation measures for construction surveys include ramp up, and measures (3-4), (7), and (9) listed above.

As described in Oleson *et al.* (2020), NARWs respond to environmental changes and may use habitats intermittently over time. They have been known to nearly abandon a frequently used foraging habitat only to come back in future years in large numbers. In recent years, NARWs have demonstrated actual shifts in distribution, frequenting previously unrecognized foraging habitats. Sighting data also indicate that NARWs may investigate a previously preferred habitat, but not stay if the prey resource is insufficient, so some habitats previously used no longer have high densities of NARWs (Davis *et al.* 2017; Davies *et al.* 2019). As described above, NARW presence in the project area is year-round; however, abundance during summer months is low compared to winter months with spring and fall serving as "shoulder seasons," wherein abundance waxes (fall) or wanes (spring). During aerial surveys conducted from 2011-2015 in the project area, NARW sightings occurred only December through April, with no sightings from May through November (Kraus *et al.*, 2016). There was not significant variability in sighting rate among years, indicating consistent annual seasonal use of the area by NARWs during those years (Kraus *et al.*, 2016). More recently, seasonal distribution patterns of NARWs have been less consistent, with NARWs observed near the project area in late summer and fall. As mentioned previously, in 2019, 2020, and 2021, NARWs were observed in August and September around Nantucket Shoals, triggering NMFS to establish a DMA that last several weeks each year; however, as noted above, these sightings around Nantucket Shoals are approximately 90 km east of the eastern-most edge of the project area, well outside the Level B harassment zones created by project activities. Given this year-round habitat usage and in recognition that where whales may actually occur during project activities is largely influenced by unpredictable, patchy prey availability, NMFS has included a suite of mitigation measures designed to reduce impacts to NARWs to the maximum extent practicable. However, even in consideration of these recent habitat-use and distribution shifts, South Fork Wind would be installing

monopiles when the presence of NARWs is lower (compared to winter), as reflected in the density data (Roberts *et al.*, 2020; Table 13). Up to a maximum of 16 monopiles will be installed, making for relatively brief elevated sound levels in/near NARW habitat (1 pile per day (at a maximum of 4 hours per day) for 16 intermittent days).

The most significant measure to minimize impacts to individual NARWs during monopile installations is the seasonal moratorium on impact pile driving of monopiles from January 1 through April 30, when NARW abundance in the project area is expected to be greatest. In addition, monopile installation must not occur in December unless an unanticipated delay due to weather or technical problems, notified to and approved by BOEM, arises that necessitates extending monopile installation through December. NMFS also expects this measure to greatly reduce the potential for mother-calf pairs to be exposed to impact pile-driving noise above the Level B harassment threshold during their annual migration through the project area. Mitigation and monitoring measures outside of those months will greatly minimize any take that may otherwise occur.

When monopile installation does occur, South Fork Wind is committed to reducing the noise levels generated by pile driving to the lowest levels practicable, such that they do not exceed a noise footprint above that which was modeled, assuming a 10-dB attenuation. Use of a soft start will allow animals to move away from (*i.e.,* avoid) the sound source prior to the elevation of the hammer energy to the level maximally needed to install the pile (South Fork Wind will not use a hammer energy greater than necessary to install piles). To reduce the daily amount of time the area may be ensonified (and thereby decrease daily exposure risk), South Fork Wind will drive no more than one monopile per day. NMFS is also requiring South Fork Wind to apply a dBBC, or a single BBC coupled with an additional noise mitigation device, to ensure sound generated from the project does not exceed that modeled (assuming 10-dB reduction) at given ranges to harassment isopleths, and to minimize noise levels to the lowest level practicable. Double

BBCs are successfully and widely applied across European wind development efforts, and are known to reduce noise levels more than single BBC alone (*e.g.*, see Table 3, Bellman *et al.*, 2020). Further, NMFS will be reviewing South Fork Wind's BBC (or dBBC) operational reports to ensure that deployments are successful (*e.g.*, the maximum air flow rate is being used during pile driving).

NMFS expects that any avoidance of the project area by NARWs due to exposure to monopile installation, cofferdam/casing pipe installation, and construction surveys would be temporary in nature, and that any NARW that avoids the project area during construction would not be permanently displaced. The IHA authorizes a total of 13 takes, by Level B harassment only, of NARWs (4 based on the maximum impact pile-driving design scenario for impact pile driving, 6 from vibratory pile driving, and 3 from construction survey using boomers and/or sparkers). Although unlikely, this may comprise 13 individuals taken once or fewer than 13 individuals taken on multiple days. For those individuals where take is limited to occurring once, behavioral disturbance and other Level B harassment impacts that may occur during exposure to elevated noise levels (*e.g.*, masking, stress) are likely insignificant. As described in the notice of proposed IHA, nearly all Population Consequences of Disturbance (PCOD) studies and experts agree that infrequent exposures from a single day or less are unlikely to impact individual fitness, let alone lead to population-level effects.

There is potential for the same individual NARW to be exposed on multiple days; however, the risk is low, and given the total number of anticipated exposures, even if a single individual were exposed on more than one day, it would not be more than a few (and that would mean that fewer total individuals were exposed). Impact pile driving of monopiles is limited to one pile per day and may only begin in the absence of NARWs (based on clearance zones, as determined by visual and PAM PSOs). If impact pile driving has commenced, NMFS anticipates NARWs would avoid the area, utilizing

nearby habitats not impacted by monopile installation. However, impact pile driving must be shutdown if a NARW is sighted at any distance, unless a shutdown is not feasible due to risk of injury or loss of life. Depending on visibility conditions, shutdown may occur based on a NARW sighting in the Level B harassment zone, thereby minimizing the duration and intensity of exposure above the Level B harassment threshold. NMFS anticipates that if NARWs go undetected and they are exposed to impact pile-driving noise from monopile installation, it would be at noise levels only slightly above the Level B harassment threshold, as it is unlikely a NARW would approach the impact pile-driving locations to the degree that they would purposely expose themselves to very high noise levels. NMFS also anticipates that the combination of PAM and visual observers (as well as communication protocols with other South Fork Wind vessels, and other heightened awareness efforts such as daily monitoring of NARW sighting databases) will result in maximum detection effectiveness such that as a NARW approaches the source (and thereby could be exposed to higher noise energy levels), PSO detection efficacy will increase, the whale will be detected, and a shutdown (if feasible) will occur. In addition, the implementation of a soft start will provide an opportunity for whales to move away from the source, reducing received levels. Although the Level B harassment zone for vibratory pile driving is large (approximately 36 km), the cofferdam, if South Fork Wind chooses to install one, would be installed nearshore over a short timeframe, at a distance approximately 70 km from the Lease Area. Further, South Fork Wind has indicated that vibratory pile driving for cofferdam installation would likely occur upon the effectiveness of the IHA in 2022, while monopile driving is likely to occur several months later in 2023. NARWs will, therefore, not be exposed to both vibratory and impact pile driving on any given day. Finally, for construction surveys, the maximum distance to the Level B harassment isopleth is 141 m. The authorized take, by Level B harassment only, associated with construction surveys is to account for any NARW PSOs may miss when

HRG acoustic sources are active. However, because of the short maximum distance to the Level B harassment isopleth (141 m), the requirement that vessels maintain a distance of 500 m from any NARWs, and the fact whales are unlikely to remain in close proximity to a construction survey vessel for any length of time, any exposure to Level B harassment (the only type that is authorized for construction survey), if any, would be very brief and exposure of the same individual on multiple days is unlikely. To further minimize exposure, ramp-up of boomers, sparkers, and Chirps must be delayed during the clearance period if PSOs detect a NARW (or any other ESA-listed species) within 500 m of the acoustic source. Operation of this equipment (if active) must be shut down if a NARW is sighted within 500 m. Overall, given the information above, the magnitude of any Level B harassment is expected to be low.

There are no known NARW mating or calving areas within the project area; however, as described above, it is on the far western edge of a larger core foraging area (Oleson *et al.*, 2020). If a NARW does avoid foraging within the project area, there is ample foraging habitat adjacent to the project area that would not be not ensonified by the project's impact or vibratory pile-driving noise. For example, the presence of NARWs on Nantucket Shoals in the fall in recent years indicates that this habitat is a foraging hotspot. Given that the nearest NARWs detections on Nantucket Shoals are approximately 90 km away from the eastern-most edge of the project area where impact pile driving monopiles would occur, noise from the project would not impact NARW foraging in this habitat. Further, monopile driving would be limited to a maximum of four hours per day; therefore, if foraging activity is disrupted due to pile driving, any disruption would be brief as NARWs would likely resume foraging after pile driving ceases.

As described above, due to the temporary nature of disturbance from South Fork Wind's project activities and the availability of similar habitat and resources in the

surrounding area, the impacts to NARWs and the food sources that they utilize are not expected to cause significant or long-term consequences for individual NARWs or their population. Feeding NARWs that may be temporarily displaced during South Fork Wind's construction activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise or when the activity ceases. Even repeated Level B harassment of some smaller number (13 or less) of individuals, as a subset of the overall stock, over several days is unlikely to result in any significant realized decrease in viability for the affected individuals, and thus would not result in any adverse impact to the stock as a whole.

With respect to potential vessel strike, the IHA includes an extensive suite of mitigation measures designed to avoid ship strike and close approaches, including, but not limited it: separation distances; limiting vessel speed to 10 kts or less (except in the case of transiting crew transfer vessels in the transit route under specific conditions, including use of observers and PAM for crew transfer vessels travelling in excess of 10 kts (outside of any DMA or SMA); training and communication protocols; and monitoring of NARW sighting resources. As described above, given the anticipated effectiveness of these measures in addition to the already very low probability of a vessel strike, take from vessel strike is not anticipated or authorized.

As described above, NARWs are experiencing an ongoing UME, the primary drivers of which are entanglement and ship strikes leading to serious injury or mortality. The loss of even one individual could significantly impact the population. However, no mortality, serious injury, or injury of NARWs as a result of the project is expected or authorized. Any disturbance to NARWs due to exposure to impact or vibratory pile-driving noise (Level B harassment) or construction surveys is expected to result in temporary avoidance of the immediate area of construction. As no injury or mortality is expected or authorized, and Level B harassment of NARWs will be reduced to the level

of least practicable adverse impact through use of mitigation measures, the authorized number of takes of NARWs would not exacerbate or compound the effects of the ongoing UME in any way.

NMFS concludes that 1) exposures of NARWs to impact pile-driving noise from monopile installation will be greatly reduced due to seasonal restrictions on monopile installation, and 2) additional required mitigation measures would ensure that any exposures above the Level B harassment threshold during months outside of the seasonal restriction on monopile installation would result in only short-term effects to individuals exposed. With implementation of the mitigation requirements, take by Level A harassment is not expected to occur and is therefore not authorized. Potential impacts associated with Level B harassment would include low-level, temporary behavioral modifications, most likely in the form of avoidance behavior or potential alteration of vocalizations (due to masking). Although unlikely given the NARW-specific mitigation, TTS is another potential form of Level B harassment that could result in brief periods of slightly reduced hearing sensitivity, affecting behavioral patterns by making it more difficult to hear or interpret acoustic cues within the frequency range (and slightly above) of sound produced during impact pile driving; however, it is unlikely that any individuals would be exposed to impact or vibratory pile driving, or active specified HRG acoustic sources at distances or for durations that would have more than brief and minor impacts, which would not be expected to affect the fitness of any individuals.

Although acoustic masking may occur, based on the acoustic characteristics of noise associated with pile driving (*e.g.*, frequency spectra, short duration) and construction surveys (*e.g.*, intermittent signals), NMFS expects masking effects to be minimal (*e.g.*, impact or vibratory pile driving) to none (*e.g.*, construction surveys). Masking events that might be considered Level B harassment have already been

accounted for in the exposure analysis as they would be expected to occur within the behavioral harassment zones predetermined for impact and vibratory pile driving.

Avoidance of the SFWF or SFEC during construction would represent a potential manifestation of behavioral disturbance. Although the project area is located within the migratory BIA for NARWs, impact pile driving of monopile foundations would only occur on up to 16 days (one pile would be driven per day for a maximum of 4 hours), and vibratory pile driving for cofferdam installation/removal would be limited to a maximum of 36 hours (18 hours for installation and an additional 18 hours for removal) of the 12 months of activities covered in this IHA. If a casing pipe and support piles are installed, impact hammering and vibratory pile driving would be limited to a total of 8 hours. Further, seasonal restrictions preclude monopile installation during the months in which NARW occurrence is expected to be highest (January through April). Monopile installation is also prohibited in December, unless unanticipated delays due to weather or technical problems arise that necessitate extending installations into December. If avoidance of the project area by NARWs occurs, it is expected to be temporary. Finally, consistent NARW utilization of the habitat south of Martha's Vineyard and Nantucket (Oleson *et al.*, 2020) indicates that suitable alternative nearby habitat would be available to NARWs that might avoid the project area during construction.

In order to evaluate whether or not individual behavioral responses (in combination with other stressors) impact animal populations, scientists have developed theoretical frameworks which can then be applied to particular case studies when the supporting data are available. One such framework is the Population Consequences of Disturbance Model (PCoD), which attempts to assess the combined effects of individual animal exposures to stressors at the population level (NAS 2017). Nearly all PCoD studies (considering multiple marine mammal species) and experts agree that infrequent exposures of a single day or less are unlikely to impact individual fitness, let alone lead to

population-level effects (Christiansen and Lusseau 2015; Dunlop *et al*., 2021; Harwood *et al.*, 2014; Harwood and Booth 2016; Keen *et al*., 2021; King *et al.*, 2015; New *et al.*, 2014; Pirotta *et al.*, 2018; Southall *et al.*, 2007; Villegas-Amtmann *et al.*, 2015). Since NMFS expects that any exposures would be brief (no more than 4 hours per day for impact pile driving of monopiles, 36 hours over 6 days for vibratory pile driving of a cofferdam, or 8 hours over 2-4 days for impact hammering and vibratory pile driving if the casing pipe is installed (and likely less given probable avoidance response)), and the likelihood or repeat exposures across multiple days to the same individuals is low (but possible), any behavioral responses that would occur due to animals being exposed to noise produced during construction activities are expected to be temporary, with behavior returning to a baseline state shortly after the acoustic stimuli ceases. NARWs may temporarily avoid the immediate project area, but are not expected to permanently abandon the habitat that contains the SFWF and SFEC. Given this, and NMFS' evaluation of the available PCoD studies, any such behavioral responses are not expected to impact an individual animal's health or fitness, or have effects on individual animal's survival or reproduction, much less impact the population.

In the IHA, up to 13 individual NARWs could be behaviorally disturbed incidental to all construction activities, or some fewer number of individual NARWs could be behaviorally disturbed on more than one day, but no more than 13 total instances of take would occur. Since most monopile installations would occur during a period when NARW occurrence is much lower than January through April (when impact pile driving of monopiles is, under no circumstances, allowed to proceed) and considering the required mitigation and monitoring, it is highly unlikely a single NARW would incur all the authorized take (*i.e.*, the same whale taken on 13 different days). Because the project area is both a migratory corridor and foraging area (although to a lesser extent than the area south of Martha's Vineyard and Nantucket), it is more likely

that a subset of whales will be exposed only once and some subset would potentially be exposed on more than one day (*e.g.*, 7 individuals taken in one day each and 3 individuals taken on two days each).

While there may be temporary impacts to behaviors such as foraging near impact and vibratory pile-driving activities, meaningful shifts in habitat use, distribution, or foraging success are not anticipated. As described above, NMFS expects NARWs to avoid areas with high noise levels. Given the suite of monitoring and mitigation measures in the IHA specific to NARWs, if an individual is exposed to noise levels that may result in Level B harassment, this exposure would likely occur at distance (*i.e.*, farther from the noise source). Because sound loses energy as it moves away from the source, more distant received levels would be relatively low; any resulting behavioral changes are also anticipated to be low in severity. Based on the information above, NMFS does not anticipate that any Level B harassment of NARWs that may result from South Fork Wind's planned impact and vibratory pile driving would impact the reproduction or survival of any individual NARWs, much less annual rates of recruitment or survival.

In summary and as described above, the following factors primarily support NMFS' determination that the impacts resulting from the South Fork Wind's construction activites are not expected to adversely affect any marine mammal species or stock through effects on annual rates of recruitment or survival:

- No mortality or serious injury is anticipated or authorized;
- Where Level A harassment is authorized, the amount of Level A harassment is low for all impacted species and would be in the form of a slight PTS;
- Level B harassment would be in the form of behavioral disturbance, primarily resulting in avoidance of the project area around where impact or

vibratory pile driving is occurring, and some low-level TTS and masking that may limit the detection of acoustic cues for relatively brief amounts of time.

- Repeated disturbance to some individuals, including a very limited number of NARWs (potentially up to a few individuals on a few days), may occur; however, any resulting behavioral reactions from exposure to acoustic impacts from the specified HRG acoustic sources, and impact and vibratory pile driving (*e.g.*, avoidance, short-term cessation of foraging) are not expected to result in impacts to any stock's reproduction or survival.
- Total authorized take as a percentage of population is very low for all species and stocks impacted (*i.e.*, less than 4 percent for all stocks, and less than 1 percent for 10 of 15 stocks);
- Areas of similar habitat value are available for marine mammals that may temporarily vacate the project area during construction activities covered in this IHA;
- Effects on species that serve as prey for marine mammals from the activity are expected to be short-term and are not expected to result in significant or long-term consequences for individual marine mammals, or to contribute to adverse impacts on their populations;
- A biologically important migratory area exists for NARWs within the Lease Area and potential export cable route corridors; however, the required seasonal moratorium on monopile installations is expected to largely avoid impacts to the NARW migration, as described above. The project area encompasses a subset of a core year-round foraging habitat; however, there are areas within this core foraging habitat that would not be impacted by project noise. Further, any noise within the project area would be temporary given the limitation to the amount of pile driving for the project, the limitations on the number of piles

installed per day, and time of day restrictions limiting when pile driving could occur. Moreover, potential for exposure from noise causing behavioral disruptions such as a cessation of foraging is further reduced through implementation of the required mitigation measures (*e.g.*, requiring a delay in pile driving should a NARW be observed at any distance by PSOs on the pile-driving/dedicated PSO vessels would limit any disruption of foraging).

- There are no known important feeding, breeding or calving areas in the project area for any other marine mammals, except fin whales. A foraging BIA exists for fin whales from March through October within the Lease Area and ECR, but ample alternate suitable foraging habitat is available in the immediate vicinity of the project area. A second fin whale BIA, and BIAs for humpback, sei, and minke whales are delineated to the east of the project area; however, received levels (if any) within these areas would be extremely low given the distance to the BIAs from the project area; therefore, exposure to these low levels (while possibly audible) are not expected to result in disruption of foraging within the BIAs.
- The required mitigation measures, including visual and acoustic monitoring, clearance zones, soft start, and ramp-up, are expected to minimize potential impacts to marine mammals and effect the least practicable adverse impact on all marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the monitoring and mitigation measures, NMFS finds that the total marine mammal take from South Fork Wind's planned activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. When the predicted number of individuals to be taken is less than one third of the species or stock abundance, the take is considered to be of small numbers. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

NMFS authorizes incidental take of 15 marine mammal stocks. The total amount of take authorized is less than 4 percent for five of these stocks, and less than 1 percent for the 10 remaining stocks (Table 23), which NMFS finds are small numbers of marine mammals relative to the estimated overall population abundances for those stocks.

Based on the analysis contained herein of the planned activity (including the required mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS finds that small numbers of marine mammals will be taken relative to the population size of all affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act

Section 7(a)(2) of the ESA (16 U.S.C. 1531 *et seq*.) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize

the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally, in this case with the NMFS Greater Atlantic Regional Fisheries Office (GARFO), whenever we propose to authorize take for endangered or threatened species.

The NMFS Office of Protected Resources Permits and Conservation Division is authorizing the incidental take of four species of marine mammals that are listed under the ESA: the NARW, fin, sei and sperm whale. NMFS requested initiation of consultation under Section 7 of the ESA with NMFS GARFO on February 8, 2021, for the issuance of this IHA. On October 1, 2021, NMFS GARFO issued a Biological Opinion concluding that these activities may adversely affect but are not likely to jeopardize the continued existence of NARW, fin, sei and sperm whales or adversely modify their critical habitat. The Biological Opinion can be found at: *https://www.fisheries.noaa.gov/action/incidental-take-authorization-south-fork-wind-llc-construction-south-fork-offshore-wind*.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (*i.e.*, the issuance of an incidental harassment authorization) with respect to potential impacts on the human environment. In compliance with NEPA, as implemented by the regulations published by the Council on Environmental Quality (40 CFR parts 1500-1508 (1978)), BOEM prepared an Environmental Impact Statement (EIS) to consider the direct, indirect and cumulative effects to the human environment resulting from the South Fork Wind project. NMFS has participated as a cooperating agency on BOEM's EIS and provided technical expertise to BOEM in development of the document as it pertains to NMFS trust resources, including marine mammals.

BOEM's Draft EIS was made available for public comment from January 8, 2021 to February 22, 2021 online at: *https://www.boem.gov/renewable-energy/state-activities/south-fork*. BOEM published a Notice of Availability of the Final EIS on August 20, 2021. As a cooperating agency, NMFS reviewed and provided comments related to NMFS trust resources, including marine mammals, on the Draft EIS and cooperating agency review draft of the Final EIS. In compliance with NEPA and the CEQ regulations (40 CFR 1506.3), as well as NOAA Administrative Order 216-6 and its Companion Manual, NMFS has reviewed BOEM's Final EIS, determined it to be sufficient, and adopted that Final EIS which adequately evaluates the direct, indirect and cumulative impacts of NMFS's proposed action to issue an IHA under the MMPA to South Fork Wind for its offshore commercial wind project. NMFS has further determined that its comments and suggestions as a cooperating agency have been satisfied and recirculation of BOEM's EIS is therefore unnecessary (40 CFR 1506.3(c)). NMFS signed a joint Record of Decision (ROD) on November 24, 2021.

Authorization

NMFS has issued an IHA to South Fork Wind authorizing take of marine mammals incidental to pile driving (vibratory and impact) and surveys utilizing specified HRG equipment associated with construction of the South Fork Wind Offshore Wind Project offshore New York, Massachusetts, and Rhode Island, for a period of one year, from November 15, 2022, through November 14, 2023. South Fork Wind is required to abide by all mitigation, monitoring, and reporting requirements in the IHA.

Dated: January 3, 2022.

Kimberly Damon-Randall,

Director, Office of Protected Resources,

National Marine Fisheries Service.

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